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Food Safety in China: Application of Traceability along the Supply Chain

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Abbreviations

TRIPS	Agreement on Trade-Related Aspects of Intellectual Property Rights
BSE	Bovine Spongiform Encephalopathy
EFSA	European Food Safety Authority
E.U.	European Union
FAO	Food and Agriculture Organization
FVO	Food and Veterinary Office
FHL	Food Hygiene Law
FSL	Food Safety Law
GFL	General Food Law
GM	Genetically Modified
GIs	Geographical Indications
GDP	Gross Domestic Product
HACCP	Hazard Analysis and Critical Control Point
HPLC	High-performance liquid chromatography
IUU	Illegal, Unreported and Unregulated
ISO	International Organization for Standardization
ACF	Member States and the Advisory Committee on Foodstuffs
MOA	Ministry of Agriculture
MOC	Ministry of Commerce
MOF	Ministry of Finance
MOH	Ministry of Health
RFID	Radio-Frequency Identification
RIA	Regulatory Impact Assessment

StCF	Standing Committee on Foodstuffs
SAIC	State Administration for Industry and Commerce
SFDA	State Food and Drug Administration
AQSIQ	State General Administration of Quality Supervision, Inspection and Quarantine
SOEs	State-owned Enterprises
P.R.C.	Peopleôs Republic of China
U.S.	United States
WHO	World Health Organization
WTO	World Trade Organization

Abstract

This dissertation is devoted to the discussion of the role of traceability system in improving food safety and compares the legislations and regulatory practices between EU and China. Europe has a renowned reputation for safe and high quality food, which is a good reference for China. It also adopts a law and economics perspective, which contributes to our understanding of the reasons why traceability functions and how the laws should be drafted to facilitate such functions. The dissertation consists of six chapters and is arranged as follows.

Chapter 1 is the introduction. The food safety problem has its unique features in China: the problem of feeding its people has already been solved, but the incidents related to microorganisms, toxic plants and animals, and chemical contamination, illegal food additives and contamination with environmental hazards repeatedly happen, which differs from that in Europe. In addition, the industry organization of the food sector in China is characterized by an overwhelming quantity of extremely small businesses using a highly decentralized way of production and processing, and usually distributing their product in the traditional wet markets with weak regulations, and differs from the pattern of massive production in Western countries. Finally, although the government is highly involved in the food production industry, the governmental intervention lacks a precautionary system in preventing the spread of unsafe foodstuffs, but highly relies on *ex post* penalties.

Now China is turning its attention to *ex ante* regulation, which depends to a greater extent on the traceability system. On February 1st, 2015, the Central Committee of the Communist Party of China and the State Council jointly released the first policy document, *The Notice on Strengthening the Reform and Speeding up the Modernization of the Agricultural Industry*, which places the traceability system and the national information platform for food safety and agricultural products as the key

to improving food safety. It is regarded as an important instrument to combat unsafe food and supply regulators, business operators and consumers with precious information.

Chapter 2 reviews the literature on the traceability system focusing on its relationship with the food safety. Section 2.1. discusses the various concepts of traceability system and its role in tracing and tracking the information along supply chain. Section 2.2. discusses the benefits and costs of traceability system. It is widely recognized that the problem of asymmetric information makes it impossible for the market to supply safe food. The traceability system standardizes the information supplied and gathers information about product attributes, which increase the availability of the decisional information. It also facilitates the court system to solve the tort disputes by assigning liabilities to the responsible parties. Finally, with the traceability system, reputation could function to distinguish the different operators, which would otherwise seem to be homogenous without sufficient information. However, the traceability system may impose significant installment and maintenance costs that prevent small and medium enterprises from using such system. Section 2.3. discusses various generations of the traceability system and their advantages and disadvantages, particularly the latest radio-frequency identification system.

Chapter 3 focuses on the legislations and regulations on food safety and traceability in E.U. Section 3.1. reviews the evolution of European food law. The history of European food law can be framed into three main phases prior to the promulgation of the General Food Law (GFL). The first one is characterized by the promotion of the Internal Market and the free movement of goods within the Community. The second turned to a new approach based on the principle of mutual recognition of laws between Member States. The third one established the basis for a radical reform of food safety regulatory framework, stressing that the E.U. food policy must be built on high food safety standards, with the aim to protect and promote consumer health.

Section 3.2. is devoted to the discussion of GFL and the regulatory framework based on it. GFL was enacted to build a harmonized food safety policy and match the fundamental aspects of food safety regulations among Member States. GFL adopts a functional approach and tries to cover every step in the supply chain, ñfrom farm to forkò, comprehensively and integrally to maintain food safety. It introduces a scientific dimension to the food safety and adopts the instrument of risk analysis, which consists of risk assessment, risk management and risk communication. In addition, if the scientific evidence is not conclusive, the Precautionary Principle is applied, i.e. when there is a positive list, the substance is deemed hazardous until the business community proves its safety, whereas such *a priori* approval procedures do not exist, then the burden of proof that the substance is risky lies on the consumer association, or public authorities. And an independent public agency European Food Safety Authority (EFSA) is created to assume the role of providing scientific evidence to the European Commissions.

Section 3.3. analyzes the protections of Geographical Indications (GIs) in Europe. The ñquality-geography nexusò stipulates that food safety and quality are determined by the geographical characteristics and the human factors. Hence, the information on the geographical origin is beneficial to consumersô choices. The GI protection in E.U. serves to achieve three policy objectives: consumer protection, producer protection, and rural development. GIs also provide information to consumers and provide monopoly power to the holders of GIs, who could charge more for their products. However, the *sui generis* protection in Europe has been complained by the United States (U.S.), which employs the system of collective and certification marks, for the noncompliance with the Agreement on Trade-Related Aspects of Intellectual Property Rights in the World Trade Organization.

Section 3.4. discusses the European regulations of traceability in the supply chain. A legal obligation is created for food business operators to identify the suppliers and direct buyers of their food or feed by the GFL. The specific regulations on beef

industry, the fishery and aquaculture products and the genetically modified food and feed are discussed respectively.

Chapter 4 gives a detailed discussion on the Food Safety Law (FSL) and related regulatory reform in China. Section 4.1. is devoted to the review of the traditional system and its drawbacks. The traditional regulatory system of food safety is both horizontally and vertically divided. The regulation of the chain ñfrom farm to forkò is segmentedly assigned to different public agencies, which are responsible to the threats to food safety in specific phases of supply-chain. To make things worse, these involved public agencies are equal in the hierarchical ladder, which makes it difficult for them to collaborate with each other. When a potential risk is concerned with two or more steps of the supply chain, the staffs of these agencies need to work together. Their equal position makes it difficult to decide the leadership among the temporary team.

Section 4.2. analyzes the FSL and the regulatory changes overcoming such inefficiencies. FSL streamlines and clarifies the allocations of the regulatory duties and creates the State Councilôs Food Safety Committee to lead the food safety management and makes national plans for food safety regulation. In addition to changes in the regulatory structure, FSL broadens the meaning of food safety regulation, which covers both the nodes in the supply chain and environment where the food is produced or processed. Finally, FSL requires that a national recall system of unsafe food should be established.

Section 4.3. talks about the risk analysis instrument introduced by the FSL. In 2011, a new independent agency, the Chinaôs National Center for Food Safety Risk Assessment is created to assume the function of assessing national risks. However, risk communication is not well performed in China. There is no systematic communication between government and consumers, except for major food safety crises, and public agencies possess significant monopoly power over food safety

information and regional/local governments would tend to distort information disclosure once the risk breaks out. The Ministry of Health (MOH) takes the responsibility of risk management and weighs policy alternatives in the light of the results of risk assessment and, if required, selecting and implementing appropriate control options, including regulatory measures.

Section 4.4. analyzes the national food safety standards and self-regulations in the firm-level that change rapidly after FSL. Ministry of Health is delegated with the exclusive power to set the national food safety standards. To consolidate different standards, the guiding principle is that the levels of contaminants should be kept as low as possible and be safe to the general public. The safe levels of the contaminants are calculated according to the dietary structure and take the total exposure into consideration. Around 303 food safety standards are promulgated during the 4 years after the 2009 FSL was enacted, which serve as the guidance for the business operators in food industry.

Chapter 5 focuses on the traceability system, both the traceability system along the supply chain and the GIs, in China. FSL does not mandate the application of traceability system and the current practices are mainly voluntary and based on business arrangements. Section 5.1. discusses the legislations and governmental policies on promotions of the traceability system. The *Twelfth Five-year Plan on National Food Safety Regulatory System* in 2012, the action plan for the food safety regulation in the next five years, explicitly set four specific goals to achieve for the traceability system. There are three public authorities involved in regulating the traceability system. Ministry of Agriculture regulates the traceability of agricultural products; Ministry of Commerce, together with the Ministry of Finance, regulates the meat and vegetable industry; and the Administration of Quality Supervision, Inspection and Quarantine regulates the market for import and export of aquatic products. The segmented regulatory system generates significant inconsistency in the regulation and compliance costs to enterprises.

Section 5.2. discusses the various interested parties involved in building the traceability system. For various levels of local government, they often have neither resources nor incentives to promote the system, although the central government is trying to promote the traceability system. For business operators, the systems are introduced haphazardly and mainly in those large firms, while the small and medium enterprises fail to install such system due to high costs. However, following the frequent occurrences of food safety incidents/crises, consumers are now willing to pay a reasonable premium to the products with traceability system.

Section 5.3. gives an analysis of the regulations of GIs in China. The dual systems of GI protection coexist in China, where the State Administration for Industry and Commerce is in charge of collective and certification marks and State General Administration of Quality Supervision, Inspection and Quarantine and Ministry of Agriculture (AQSIQ) is in charge of *sui generis* protection. The government is highly involved in the *sui generis* protection system, where the local government will appoint the applicants, who later file applying documents including information on the geographical area, the creation of the applying organization, the application form for GIs including the explanations for the geographical features, the link between these features and the natural factors and humanity, standards for production and the history of the product, and the technical standards for the product, to AQSIQ for review.

In contrast, the certification and collective marks protections of the GIs involve little intervention of public authorities and mainly rely on the private negotiations. The applicants file the materials to the Trademark Office of China, which assumes no roles in searching for conflicting rights. If no interested parties raise oppositions within three month, the Trademark Office will grant the registration. In addition, the technical standards and governance rules are drafted by applicants and monitoring activities are assumed by the holders of the certification and collective marks.

Section 5.4. carries a case study on the Longjing Tea and provides a vivid picture about how the traceability system functions in China. The *sui generis* GI protection system takes a leading role and documents detailed materials about the geographical area, the technical standards for plantation, cultivation, plunking, storing and processing activities. However, there is no established national traceability system for the Longjing Tea. Some efforts are made in the laboratories, such as the High-performance liquid chromatography and near-infrared technology are employed to test the authenticity of the claimed Longjing Tea, which makes it possible to trace back to the origin.

Chapter 6 concludes the dissertation. The traceability system has been proven to be a cure for the problem of asymmetric information in the food market, which could accumulate the information of the geographical origins and along the supply chain. Information is important for consumers to make appropriate choices, without which consumers need to spend high costs in searching and verifying to avoid consuming unwanted foodstuffs. More importantly, information is also important for public regulators to carry out targeted withdrawal and recall of food when a food crisis has already been revealed and to assign the costs of unsafe food to the sources. The history and evolvement of the food safety legislations in E.U. show that assurance of safe food should be positioned as the first priority. A functional perspective could be beneficial to food safety regulation, which covers every step in the supply chain, ñfrom farm to forkò, comprehensively and integrally. In addition, scientific instruments, such as the risk analysis system, are crucial for the ends of safe food. A precautionary way to deal with the issue rather than *ex post* intervention is more efficient and possible to avoid damages.

The food safety problem in China has its unique features and transplanting the European regulatory system completely is neither suitable nor feasible. Although China has been learning from and catching up with the European food safety

regulation, there are still significant room for improvement. The newly enacted FSL, to some extent, changes the prior situation that the regulatory duties are divided among various public agencies, which is sure to leave gaps and overlaps of regulations and is regarded as the major cause for repeated food safety crisis. In addition, every participant along the food supply chain is assigned with the responsibility of ensuring the safe provision of foodstuffs. Although all these legal improvements could only be effective only if the enforcement of laws and regulations is increased and the segmented and multiple governmental regulations are unified and coordinated.

To supplement the overall reform of the food safety regulation, China has already noticed the important role of traceability system in providing food safety information. However, it is still mandated by the legislations, which could be possibly ascribed to the high installment and maintenance costs. Finally, dual systems of GI protection coexist in China, where SAIC is in charge of collective and certification marks and AQSIQ and MOA is in charge of *sui generis* protection. The GI system has contributed to protection of traditional heritage and improved the life in rural areas, yet the conflicts and overlaps between the two systems compromise their effectiveness. The creation of a national traceability system will become a good opportunity for China to improve its food safety, as it will provide precious information needed by regulators, producers and consumers.

1. Introduction

China has achieved spectacular economic growth and maintained nearly 10% of Gross Domestic Product (GDP) annual growth rate over the last three decades. The food industry, which accounted for around 10% of GDP, has contributed to such strong economic growth. As is shown in Figure 1.1, the annual GDP of the agricultural industry in China has quadrupled in the last decade, which successfully provides living substance for the population in most of the regions in China.[1] Although the rest three industries are relatively small compared to agricultural industry, they also grew quite fast and provided diversities to the meals of local residence. The increases in the agricultural productivity are mainly ascribed to the improvement in the technology, such as high-yield grains, the new equipment, the introduction of new animal feeds and genetics (Carter, Zhong and Zhu, 2012).

However, the industrial organization of the food industries in China has its unique features, which differ from the pattern of massive production in European Union (E.U.) and the U.S. In 1980s, China carried out a series of agricultural reforms that divides up land among villagers on an equal basis, which created an industry consisting of small, fragmented landholdings. As a socialist country, the land is owned by the country or collective and cannot be traded. Hence, the large and medium enterprises have accounted for a large proportion of the annual sale in the food industry, but there is still an overwhelming quantity of extremely small businesses in the food industry, which use a highly decentralized way of production and processing, and usually distribute their product in the traditional wet markets with weak regulations.[2] The large number and small scale of agricultural business makes it

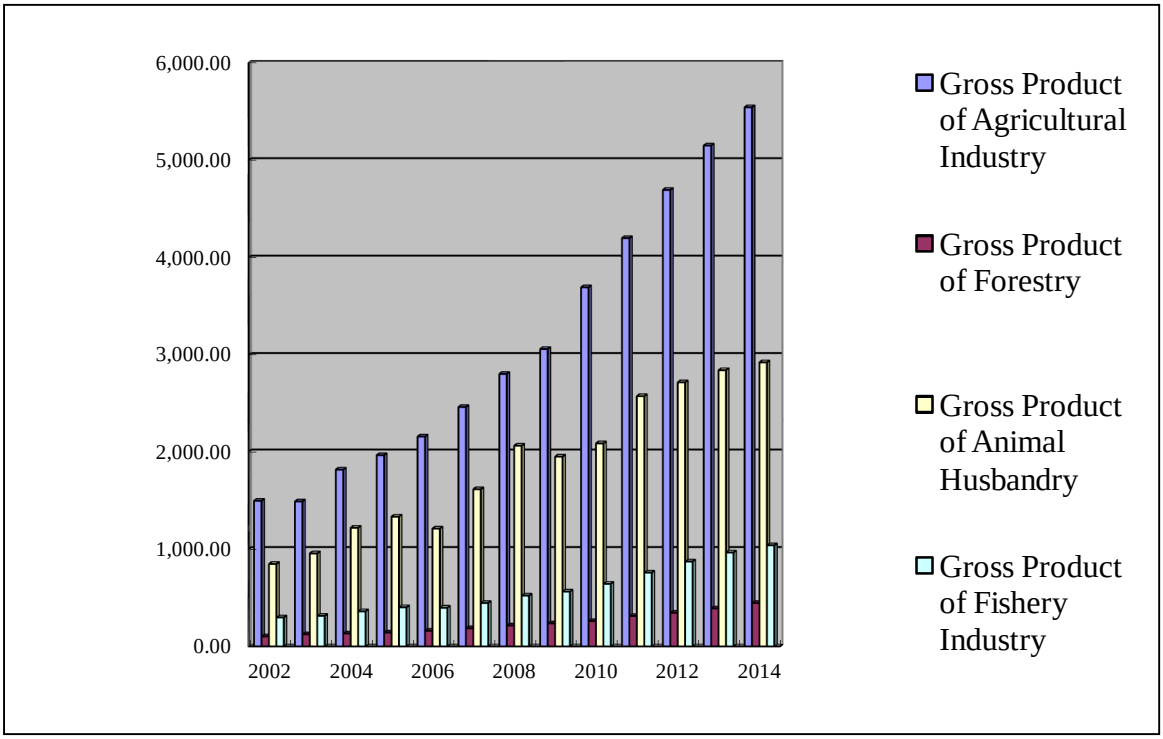
[1] It worth noticed that not all the agricultural products are edible. However, due to data availability we use the industrial data to proxy for the conditions of the edible agricultural products.

[2] For example, a case study carried out in Shijiazhuang city shoes that the extensive abuse of

difficult to standardize the production process, upgrade technology and establish traceability systems (Gale and Hu, 2012).

Figure 1.1 Annual Gross Product of Agricultural Industry, Forestry, Animal Husbandry, and Fishery Industry from 2002 to 2014

Billion RMB



Sources: National Bureau of Statistics of China

According to the *2007 Report for Food Quality and Security in China* (henceforth *2007 Report*) released by The State Council Information Office of the Peopleôs Republic of China (P.R.C.),[3] more than 353,000 small businesses with fewer than ten employees engaged in food production and took about 9.3 percent of the gross production of the industry. The rest 92.7 percent of the market demand is satisfied by

pesticides and adulteration are the main food risks (Liu, Zhang and Zhang, 2014).

[3] For details of the report, see http://news.xinhuanet.com/newscenter/2007-08/17/content_6552904.htm (In Chinese).

95,000 enterprises with more than 10 employees.[4]

The general conditions of the food safety in China are in correspondence with the structure of the food industries where small businesses dominate. It is an extremely diverse sector, in which one-size-fits-all standards of hygiene and inspection are deemed to fail. According to the *2007 Report*, around 85.1% of the products pass the spot checks with the national quality standards in 2007, which surpassed the rate of 77.9% in 2006.[5] The review of a series of surveys on food quality reported in Table 1 of Wu, Zhang, Shan, and Chen (2013) shows that the general public is highly concerned with food safety in China, with around 70% percent of respondents reporting insecure feelings about foodstuffs.

The industrial organization of the food industries brings about significant risks to the food safety and quality.[6] On one hand, the small businesses fail to achieve economy of scale and are featured with production with outdated technology and low quality. For example, most of the businesses run in the traditional wet markets are without any license, and hence out of the *ex ante* regulations of the public authority. Economic performance of those small firms with low profit margin will fall significantly if laws and standards applied to large enterprises are widespread implemented. The operational costs will increase and the competitiveness of small firms will decrease. On the other, small operators lack incentives to invest in supply chains or sanitation of production. It is even worse when market participants would like to make as much

[4] A more recent statistic shows that the enterprises above the designated scale (usually the large and medium enterprises) realized the annual sale of 9,284.73 billion RMB, with annual growth rate of 14.3% in 2013, see http://www.chyxx.com/industry/201403/232589.html (In Chinese).

[5] It is possible that the standards employed in these spot checks are far below those in E.U. and the U.S. due to the fact that China is still developing its economy and food industries.

[6] Carriquiry and Babcock (2007) show that market concentration and public reputation could improve the welfare of the consumers.

profits as possible. Due to asymmetric information, consumers cannot distinguish those products with unlawful chemical additives used in production, processing, packaging, and distribution phases, which make products attractive.[7]

Food safety is becoming a prominent concern in China, according to the *'Twelfth Five-Year Plan' of the National Regulatory System of Food Safety* released by the General Office of the State Council in 2012, which identified five major problems of the national regulatory system of food safety, including first, the enforcement ability of the regulatory system in the municipal level and in the western regions is weak; second, laws and related standards are incomplete[8]; third, the ability to assess the risks and technological investment are lagged behind; and fourth, the participants in the food industries need more education on the laws and standards of food safety.

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[7] Based on the availability of the information on the product attributes, Nelson (1970) distinguishes among search, experience and credence goods. For search goods, consumers could determine their quality before buying them through examining them. For experience goods, consumers could only determine their quality after they consume or use them. Finally, for credence goods, consumers could not determine their quality even after they consume or use them. Foodstuffs generally are experience goods, some of which even have credence attributes. Due to this property, consumers are lack of information on the product.

[8] The most prominent problem with the legal system in China is that the costs of committing crimes are relatively low due to the low probability of getting caught and the penalties of the crimes. According to Becker (1968), individuals committing crimes will weigh the expected costs and benefits of the behavior. Given the expected benefits of crime, the increase of the expected costs will significantly decrease the incidence of crimes. The expected costs of the crime equal the magnitudes of punishment demanded by the laws multiplied by the probability of getting caught determined by the enforcement strategies. The *2014 Amendments to the Food Safety Law of the People's Republic of China* (*2014 Amendments to the Food Safety Law*) addressed the problem of low penalties, and laid down the harshest liability for committing crimes that endanger the food safety.

Such concerns for food safety is not without reasons as both real and perceived, domestic and international, food safety problems. For example, in 2006 Belgium, a member of E.U., found that their farming industries, particularly those raise chickens and pigs, suffered from the dioxin contamination. The nearby Dutch farms also experienced significant losses due to the possibility of similar contamination. The scandals in China are much more frequent and severe. Table 1.1 reports the number of food safety incidents and victims of mainland China in 2011 and 2012. In 2011, there were around 809 cases of food crisis and 14057 victims suffered from these incidents, while in 2012 although the number of victims is reduced to 13679, the frequency of the incidents increases to 917. We can read from the table that Yunnan province has a significant high number of incident and patients compared to the rest of provinces. No signs of reduction in the food safe incidents could be clearly identified.

The food safety incidents show a lack of precautionary efforts in preventing the spread of unsafe foodstuffs, because government intervened quite often after the damages were made. In 2008 the former nation-wide diary producer *Sanlu Group* was found to add melamine into infant formula milk powder, and caused significant harm to nearly 300,000 infants across the country.[9] The multinational company, *Husi Food*, was revealed to provide out-of-date meat to the international fast-food chains McDonaldôs and Kentucky Fried Chicken in July, 2014, which significantly compromised the consumersô confidence because the international fast-food chains have built strong reputations for strict monitoring of food safety. As a result of the concerns about the domestic food safety, consumers swift their demands to imported products produced by those countries that have built reputation for food safety, such as E.U. and U.S., though they would have to pay much higher price. It is harmful to the local producers because they lose a large proportion of sales with high profit margins.

[9] For the statistics, see http://politics.people.com.cn/GB/1026/8893711.html.

Table 1.1 The Number of Food Safety Incidents and Victims of Mainland China in 2011 and 2012

	Number of incidents		Number of patients	
Year / Regions	2011	2012	2011	2012
Beijing	34	25	495	368
Tianjin	12	3	221	64
Hebei	15	20	235	495
Shanxi	31	25	800	351
Inner Mongolia	6	5	179	215
Liaoning	20	8	461	88
Jilin	6	10	117	456
Heilongjiang	14	5	336	79
Shanghai	6	12	126	175
Jiangsu	36	43	568	519
Zhejiang	32	37	594	410
Anhui	56	53	906	535
Fujian	17	35	429	388
Jiangxu	2	3	15	6
Shandong	8	9	335	302
Henan	13	5	216	159
Hubei	11	10	165	216
Hunan	36	39	870	762
Guangdong	87	98	1132	1003
Guangxi	21	50	557	642
Hainan	12	25	114	430
Chongqing	33	39	808	798
Sichuan	29	28	431	344
Guizhou	80	72	949	693
Yunnan	152	208	2307	3499
Tibet	N.A.	N.A.	N.A.	N.A.
Shaanxi	1	2	21	41
Gansu	25	28	382	391
Qinghai	8	6	189	79
Ningxia hui autonomous region	6	11	99	127
Xinjiang uygur autonomous region	N.A.	3	N.A.	44
Total	809	917	14057	13679

Source: *The Yearbook of Health and Family Planning in China*, the National Health and Family Planning Commission of the PRC, available at http://www.nhfpc.gov.cn/htmlfiles/zwgkzt/ptjnj/year2013/index2013.html.

Several factors happening during the 30 yearsô reform contribute to the problem of food safety. First, as the national income rises, the overall expense on foodstuff and its diversity have increased significantly (Cao, Tian, Wang, Malcolm, Liu and Zhou, 2013). Second, consumptions on the foodstuffs outside home in the restaurants have grown 159 fold from 1978 to 2008 (Hawkes, 2008). Hence, the national residents face a higher risk exposure to unsafe food. In addition, the rapid economic growth leaves side effects on food safety (Lin, Zeng, Li and Ni, 2014). On one hand, the inequality of income and demographic shifts undermine the safe food production. The urbanization process attracts migrants from rural area to work in big cities, which results in fewer young residents living in the rural area. The situation reduces the new labor force entering into the local agricultural sectors, and hence the quality of the foodstuff (Banister, Bloom and Rosenberg, 2010). On the other, the water and land system are highly polluted, such as heavy metal pollution, which lead to unsafe foodstuffs (Chen, 2013; Lu et al., 2015).

There are bipolar ways to regulate food safety, *i.e.* public and private food safety control systems (Henson and Caswell, 1999). Public intervention combines the regulation of standards, investigations and testing with the product liability system,[10] whereas private control system includes self-regulations, such as internal control systems and provisions of information, and certifications by third parties. It is less likely to maintain food safety purely relying on the incentives of private parties without any governmental interventions. As profit-maximizers, they have strong impetus to supply low-quality products, including those unsafe foodstuffs, which generate high returns. Antle (1996) argues that government regulation is specially needed, where the knowledge of consumers is inadequate and costs of verification are high. On the other hand, only relying on public intervention, for example, allocating

[10] Product liability system is *ex post* remedy that victims of the unsafe foodstuffs seek compensation from companies through court system. It usually plays a secondary role as most of the countries would take a precautionary mode to protect food safety.

the rights to produce foodstuffs exclusively with state-owned enterprises (SOEs), could also lead to significant costs. SOEs lack of appropriate incentives, which increase the costs of production. Consequently, the optimal way with minimized costs should be a combination of government regulations, which establish *ex ante* laws and quality standards of foodstuffs,[11] and private production, which enjoy the benefits of appropriate market incentives (Shleifer, 2005).

Ascribed to the continuous scandals on foodstuff safety, the business is pushed to improving the quality of their supply chain, especially the transparency along the chain (Beulens, Broens, Folstar and Hofstede, 2005).[12] Such transparency reveals a variety of information on the product safety containing the origin of the item, its component, and the processing history (Regattieri, Gamberi, and Manzini, 2007), which are priced with premium by consumers (Latouche, Rainelli, and Vermersch, 1998). It also differentiates the seem-to-be homogenous suppliers and shows their potential efforts in protecting food safety.

This dissertation is devoted to the discussion of the food traceability system, which is one of the most important quality assurance systems, the core to maintain transparency in the supply chain, and relies on the private efforts in improving food safety, the related food safety regulatory framework, and the benefits and costs of implementing such system in China, with the reference to the best practice and cases

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[11] ISO 9000 defines that ñQuality is the totality of features and characteristics of a product or service that bear on its ability to satisfy stated or implied needs (pp.16).ò Hall (1989) stresses that it is crucial to disentangle the abstract quality into requirements, and to map these requirements into specific goals, objectives, constraints, input-output, and detailed system that will satisfy these needs. The traceability system is employed to provide information for these components.

[12] Transparency of a supply chain network is defined as the ñthe extent to which all the networkôs stakeholders have a shared understanding of, and access to, product and process related information that they request, without loss, noise, delay and distortionò (Hofstede, 2002).

in E.U.. Europe has already built a multi-layered control system in its food sector, with Member States for official controls and enforcement of food law and self-control system, such as Hazard Analysis and Critical Control Point (HACCP)-based systems and traceability system for safe food production, adopted at the firm-level (van der Meulen and Freriks, 2006). In addition, a rapid alert system involved the Member States, the Commission and the European Food Safety Authority (EFSA) functions to notify the identified direct or indirect food or feed risks to human health, which tries to minimize the costs of a food crisis. Such system functions well to solve a potential crisis of milk in Netherlands, Belgium and Germany in 2004, after a routine inspection found that levels of dioxin in the milk at a farm near Lelystad in the Netherlands exceeded the six times of the statutory maximum amount. The public authority quickly intervened and investigated the sources of the contamination, which is shown to be the feed of the animals. The traceability system quickly identified the materials unsold and 162 farms in the Netherlands, 8 in Belgium and 3 in Germany that have brought the animal feeds. Because the contamination was not restricted to the Netherland, the Dutch food safety regulators also reported to the European Commission to coordinate these countries and mitigate the public panic on the milk safety and restore consumersô confidence.

The author sees the traceability system as an important instrument to improve food safety, and to help regain the consumersô confidence in China, although the system itself does not have the exact effects of reducing the hazards of foodstuffs as for example, the improvements in the tests for microbiology or chemicals. It accumulates important information about the product along the supply chain, like an identity card, that is crucial for decision makers.[13] To develop a scientific traceability system in China would also facilitate the goals proposed by the *2014 Amendments to the Food Safety Law*, which tries to establish the strict ñin the courseò regulatory system. On

[13] The advantages of food traceability system in providing decisional information has obtained growing notices, see Golan, Krissoff, and Kuchler (2004) for a discussion.

one hand, it emphasizes the regulation in the manufacturing and processing phases, rather than *ex post* remedies after that the scandals are revealed. On the other, it proposes to increase the regulatory efforts in the circulation phase and assign the liabilities to specific entities. All these ends would not be efficiently achieved without a scientific and effective tractability system, where decision makers could draw relative information.

The dissertation is arranged as follows: Chapter Two reviews the law and economic literature on the traceability system, especially those discussions on the multiple roles the system plays and the related costs and benefits. The most prominent problem in food industry is the asymmetric information. The food market is full of experience and credence goods, which consumers could only determine their quality after they consume or use them, or even unable to determine their quality. Due to the prolonged supply chain (including producing, processing, packing, distributing, and retailing, etc.), it is highly likely that business operators have little knowledge about their upstream and downstream firms, let alone the quality of their products. Such asymmetric information could make market contracts inefficient as it is extremely hard for firms to select counter parties. As a result, suppliers tend to provide materials and ingredients with lower quality, *i.e.* they suffer from the problem of moral hazard. Anticipating such behaviors, the down-stream participants will pay less, which further drives away those high-quality suppliers. The market will be at a bad equilibrium as the result of adverse selection.

The traceability system, which is defined as ñthe 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 distributionò[14], could effectively mitigate consumersô shortage of information. Moe (1998, pp.211) points out that the traceability system should be able to perform dual

[14] Regulation (EC) No 178/2002, para. 15.

functions, *i.e.* ñtrack a product batch and its history through the whole, or part, of a production chain from harvest through transport, storage, processing, distribution and sales (hereafter called chain traceability) or internally in one of the steps in the chain for example the production step.ò The traceability systems gather information about product attributes and provides standardized information on locations while the product moves through the supply chain. The information accumulated could be divided into two groups, one is the information on the origins and components of the products, *i.e.* the geographical origins, and the other is the information along the supply chain.

Combined with the regular inspection instruments, the traceability system motivates the suppliers to provide foodstuffs by making it possible to assign the costs of unsafe food to the sources (Starbird and Amanor-Boadu, 2006). It brings about positive benefits, including first traceability system could facilitate *ex post* reactions to the crisis that have revealed. Operators and public regulators are able to trace back to the sources of contaminations and effectively recall those contaminated products. In addition, the traceability system provides evidence for the private litigations that seek civil compensation. The exact identification of the liability internalizes the negative externality of the contaminated food, which, *ex ante*, provides appropriate incentives for operators to supply safe food. Finally, *ex ante* the system reduces consumersô searching and verifying costs and help reputations to work effectively. Without sufficient information, reputation becomes public goods, that is to say that individual firms could not exclude competitors to consume (damage) the reputation of a group of firms in a given industry due to limited information about the firm. Hence, individual firm will have incentives to over-consume the reputation, which generates significant negative externality to the industry.

The traceability system also has become an indispensible component of the modern regulatory framework of the food safety (Bollen, Riden and Cox, 2007). It has been integrated into the management of the agri-food supply chains, including production,

processing and retailing stages, and providing critical information for decisions. For production stages, the system ensure that the special trait of the product is preserved. For processing stages, the industrial standards are applied and enforced to guarantee the product safety. And for retailing stage, traceability system provides detailed historical information about the product, which is crucial for regulatory purposes and knowledge of consumers.

Chapter Three discusses the legal and regulatory practices of food safety in E.U. with the focus on the General Food Law (GFL) and the regulations on chain traceability and geographical indications (GI). The regulatory framework of food industry has a long history and its priorities have been changing. At the first half of the history, from 1957 to 1997, the top priority of the food industry regulation is to promote the common market and harmonization of the food regulation among Member States. The 1957 Treaty of Rome was not made any direct reference to a food regulation. In fact, the regulation of the sector benefits from the indirect side effect of the efforts made to eliminate trade barriers arising from different legal systems in different member states, with the objective to implement an internal market. The basic principles on which this goal is based were four: the free movement of labor, the free movement of services, the free movement of capital and the free movement of goods. The latter gave the major contribution to the creation of a common framework for food regulation (van der Meulen, 2013).

Due to the Bovine Spongiform Encephalopathy (BSE) crisis, the public got scared by unsafe foodstuffs and loses its confidence in the industry, which caused great damages. Hence, from 1997 until now, the history represents a era of regulations promoting safe food. In May 1997, it was launched the *Green Paper on the General Principles of Food Law* in the E.U., with the objective to create the basis for a reform in the food safety management at the Community level. According to the Communication, ñthe health protection in relation with the consumption of foodstuffs is to be an absolute priority at any time and not only something to be looked at in emergency situationsò.

Six priorities were set and the concept of control over the entire food chain was introduced (ñfrom farm to forkò), which include all operators involved in the production and distribution of food.

In 2002, GEL was promulgated and adopted a functional approach trying to cover every step in the supply chain comprehensively and integrally to maintain food safety in E.U. The Community adopts a scientific instrument, the risk analysis, to achieve the ends of safe food. Article 3(10) of GFL decomposes the concept into ña process consisting of three interconnected but separately assumed components: risk assessment, risk management, risk communication.ò The EFSA is responsible for the function of risk assessment and risk communication, the European Commission for risk management, and the Member States for enforcement.

The traceability system including chain traceability and GIs is regarded as an important component of the modern food safety regulation system. The implicit assumption that ñquality-geography nexusò exists underlies the GI protection. The origin place of the product, which determines the geographical characteristics and the human factors, is an important determinant of the food safety and quality. The GI provides information for the original place of the product, which consumers rely on to make decisions. Products originated from protected GIs are estimated to generate a total sales around 14 billion Euros, with round 8.9 billion in Italy, 2.3 billion in France, 0.9 billion in Spain and 2.0 billion in Germany (Profeta, Balling, Schoene, and Wirsig, 2009). Due to its importance, E.U. has offered *sui generis* protection to GIs ever since 1992.

The GI protection in E.U. serves to achieve three policy objectives: consumer protection, producer protection, and rural development. For the first two policy objectives, GIs reduce the asymmetric information, which results in market failure, between the consumers and producers. For the third objective, GIs actually grant collective monopoly power to the firms located in the region, which will attract new

generations to stay in rural areas. The fixed investments involved in obtaining the protection of GIs deter the new entrants. In addition, GIs provide possibility to protect the indigenous peopleôs knowledge rather than the new creativity, an important component of cultural diversity, which gains no attention from the modern trademark system.

However, the existing regulatory framework of GIs has some inconsistencies with the international agreements on GI protection. One of the most important international agreements regulating GIs is the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) in the World Trade Organization (WTO), the Article 22 to 24 of which are dedicated to the issues related to geographical indicators, and set the minimum standards for international protection to avoid usage of marketing strategy that misleads consumers. The protection is limited to the place of origin where the product comes from, but does not include the human factors (Echols, 2003). The wine and spirits are given a higher level of protection than other agricultural products, which are specifically dealt with by the Article 23 (Gutierrez, 2005).

Yet due to the ambiguous natural of the protection required by TRIPS, the contracted States differ in their attitudes towards the way in which GI should be protected. The U.S. is the leading opponent to the European approach, and counter for placing the GI with equal protection of the trademark, because the protection of GIs is in conflict with the trademark system supported by U.S., which emphasize the new creativity. It adopts a ñcertification marksò approach to regulate the GIs, where the certifying entity, instead of the producer, owns the certification marks. Unlike trademark protection, which generally limits new entrants to the market, the certification mark allows free entry if the producer fulfills all the specifications for certification. And unlike the reliance on public intervention in Europe, the certifying organization will devote resources to policing the mark-holders and investigating infringements. Due to these differences, the American firms are less dependent on the certification marks to protect their reputations.

Due to the international pressure, especially the judgment made by the WTO panel that EU regulations violated the equivalence and reciprocity conditions with respect to the availability of protection for GIs (Marette et al., 2008), E.U. modified its previous position, and published a new regulation on GIs, Council Regulation (EC) No 510/2006 (*GI Regulation 2006*). The new regulation makes important changes in the process of application. Previously non-European stakeholders are required to involve their national governments insofar as application and objection procedures of GIs, whereas the Member States are bound by the regulation to handle their citizensô applications, which discriminates the non-European stakeholders because of their heavier burdens in using the procedure. The *GI Regulation 2006* permits stakeholders to apply and object a GI either directly from the third country or via its government.

The protection of food safety via traceability system along the supply chain is mandated by the Article 18 of GFL, the beginning of which recognizes that the function of the Internal Market could be jeopardized without the traceability system.[15] It requires that ñthe 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.ò[16] The requirements are quite extensive as the transportation and storage are included.

The Community has promulgated traceability regulation of the beef industry, the fishery and aquaculture products and the genetically modified (GM) food and feed respectively. Due to the BSE crisis, the new regulation, Regulation (EC) No 1760/2000, stipulates mandatory requirements that Member States should establish a system for identification and registration of bovine animals, *i.e.* it requires detailed requirements on the traceability and labeling of the beef and beef products circulated

[15] GFL, para. 10.

[16] GFL, art. 18 (1).

in E.U. In addition, the Commission issued a special regulation on the traceability and labeling of fishery and aquaculture products, which requires that the species, method of production, and geographical origins (farming area) should be provided by means of labeling, packaging or a commercial document.[17] In addition, the traceability system is important for fishery industry because E.U. employs it to achieve another policy goal to combat with illegal, unreported and unregulated (IUU) fishing, which the Council Regulation (EC) No 1005/2008 is directed against (Andre, 2014).

Finally, due to GM foodôs scientific uncertainty on environment, human, animal and plant health, the Community also adopts a process-oriented regulatory approach. A unique feature of the traceability system for GMs is the post-release monitoring plan, which establishes the traceability system after the products are sold. Such plan ensures that the assumptions underlying the proposed assessment are correct and unanticipated adverse effects on human health or the environment could be tracked. Yet such requirements are not applied to products, which contain ñadventitious or technically unavoidableò traces of authorized GM organisms in a proportion no higher than 0.9 per cent of the food ingredients (Anker and Grossman, 2009).

Chapter Four reviews and discusses the newly enacted Food Safety Law (FSL) and the regulatory system based on it in China. The previous regulatory system of the food safety in China has been proven to be inefficient, which is both horizontally and vertically divided. The regulation of the chain ñfrom farm to forkò is segmentedly assigned to different public agencies, which are responsible to the threats to food safety in specific phases of supply-chain. The basic legal rules governing the food safety is the updated 1995 Food Hygiene Law (FHL), which was enacted in 1983 on trial. The FHL was quite general and only applied to the food production process, which excluded other parts of food supply chain, such as planting, breeding, storing and transporting process. The 1995 version of FHL designated the regulatory power to

[17] Regulation (EC) No 2065/2001, art. 8.

the MOH and set forth the general standards for the content, additives, packages and manufacturing conditions of foodstuffs. The civil, administrative and criminal liabilities are put in place to punish violations of the prescribed duties.[18] However, FHL was drafted two decades ago, the monetary penalty set for failure of sanitary standard was 5,000 RMB, which provided no deterrence to potential crimes.

To overcome the regulatory failure, the State Council decided to reform the regulatory system, and enacted the FSL in June 2009 after 5 years of drafting. FSL streamlines and clarifies the allocations of the regulatory duties and broadens the meaning of food safety regulation, which covers both the nodes in the supply chain and environment where the food is produced or processed. The instrument of risk analysis, which consists of risk assessment, risk management, and risk communication, is adopted as the innovative instrument to assure safe food. However, in contrast to the science-based food safety regulation, the risk analysis process is not pure scientific and is compromised by the political influence. In addition to the risk analysis system, a series of national standards are enacted to set unified norms for foodstuffs. The Article 18 of FSL requires that food safety standards should ñensure the physical health of the general publicò, which leads to around 303 national food safety standards from 2010 to 2013. Although these standards incorporate more recent development in the food sector, the complicated and segmented regulations still undermine the effectiveness of the standard system.

Chapter Five analyzes the traceability system of food safety in China, which is recently developed to combat food safety crisis. It increases the ability of the firm to manage the flow of inputs and outputs, to improve distribution efficiency, to differentiate their products, and to perform accurate and targeted withdrawals. The system mainly consists of two parts: the traceability along the supply chain and GIs. FSL does not mandate that food operators adopt the traceability system, though its

[18] FHL, art. 37-41.

articles have required some functional characteristics of the traceability system. The State Council issued the *Decisions on Strengthening the Food Safety Regulation* in 2012, which is regarded as the general guiding principles for the building of food safety regulation and repeatedly mentioned that traceability systems should be established to achieve various goals.

The regulations on the traceability system along the supply chain in China are mainly issued by three public agencies: Ministry of Agriculture (MOA) issued the *Regulation on the Traceability System of Harm-Free Agricultural Products* (the 2011 *Regulation on the Traceability System*) in 2011 to regulate the agricultural market; the Ministry of Commerce (MOC), together with the Ministry of Finance (MOF), issued the guidance on building the pilot projects of the traceability system of the meat and vegetable in 2010; and State General Administration of Quality Supervision, Inspection and Quarantine (AQSIQ) issued the *Measures for Supervising the Inspection and Quarantine of the Import and Export Aquatic Products* in 2011 to regulate the market for import and export of aquatic products.

On the other hand, the regulation of GIs is comprised of two parts: the European *sui generis* protection and American certification and collective trademarks. The two systems are administered by different governmental agencies. The collective and certification marks are regarded as a means of active protection, whereas the *sui generis* protection is devised to provide AQSIQ and MOA to manage the appellations of origin. However, the dual systems result in significant conflicts in their legal priority, the production standards and intensity of the enforcement. A case study of the Longjing Tea in Zhejiang Province vividly shows how the GI protection system functions in China. The *sui generis* protection system provides detailed technical standards for Longjing Tea production. Several methods to test the authenticity of the claimed Longjing Tea are also developed to increase its traceability to the origin.

Finally, Chapter Six concludes the dissertation and makes policy recommendations.

The traceability system has been proven to be a cure for the problem of asymmetric information in the food market, which could accumulate the information of the geographical origins and along the supply chain. The information is important for consumers to appropriate choices, without which consumers need to spend high costs in searching and verifying to avoid consuming unwanted foodstuffs. More importantly, the information is important for public regulators to carry out targeted withdrawal and recall of food when a food crisis has already been revealed and to assign the costs of unsafe food to the sources. The history and evolvement of the food safety legislations in E.U. show that assurance of safe food should be positioned as the first priority. A functional perspective could be beneficial to food safety regulation, which covers every step in the supply chain, ñfrom farm to forkò, comprehensively and integrally.

The food safety problem in China has its unique features and transplanting the European regulatory system completely is not suitable. Although China has been learning from and catching up with the European food safety regulation, there are still significant improvements that could be made. The newly enacted FSL, to some extent, fails to solve the problem that the regulatory duties are divided among various public agencies, which is sure to leave gaps and overlaps of regulations and is regarded as the major cause for repeated food safety crisis. In addition, the enforcement of laws and regulations is still weak in China, which compromises the effectiveness of the legal improvements. Finally, the dual systems of GI protection coexist in China, where the conflicts and overlaps between the two systems reduce their efficiencies and impose great administrative costs on business operators.

2. Food Traceability and Asymmetric Information: A Literature Review

The traceability system emerges only after the contemporary food production system comes out, which requires large number of small steps performed dispersedly in the regions with their comparative advantages. A growing number of nations have established the traceability requirements in addition to private efforts, realizing that the system could provide proper incentives to suppliers to maintain the quality of their products. The traceability systems gather information about product attributes and provides standardized information on locations while the product moves through the supply chain.[19] The information accumulated could be divided into two groups, one is the information on the origins and components of the products, and the other is the safety information along the supply chain. Combined with the regular inspection instruments, the traceability system motivates the suppliers to provide foodstuffs by making it possible to assign the costs of unsafe food to the sources (Starbird and Amanor-Boadu, 2006).

The traceability system has also become an indispensible component of the modern regulatory framework of the food safety (Bollena, Ridena and Cox, 2007).[20] It has been integrated into the management of the agri-food supply chains[21], including

[19] Popper (2007) argues that the traceability system poses threats to the privacy of the individuals along the supply chain and fails to identify the extent to which the systems could look into, which is ignored by the regulations.

[20] For example, the recall system for food safety functions properly only with the effective traceability system (Regattieri, Gamberi and Manzini, 2007).

[21] The agri-food supply chains is used to describe the activities ñfrom production to distribution that bring agricultural or horticultural products from the farm to the tableò (Ahumada and Villalobos, 2009: 2).

production, processing and retailing stages, and providing critical information for decisions.[22] For production stages, the system ensure that the special trait of the product is preserved, for example, the use of buffer zones as preventative measures for avoiding cross-pollination. For processing stages, the industrial standards are applied and enforced to guarantee the product safety. And for retailing stage, traceability system provides detailed historical information about the product, which is crucial for regulatory purposes and knowledge of consumers. However, the literature also cautions against the pure reliance on traceability systems, which Loureiro and Umberger (2007) report is only valued positively if the participants in the supply-chain provide safety food. This Section provides a general discussion of the literature on the food traceability, including its concept and key components, the economic and managerial rationales to establish such system with an emphasis on its role in mitigating asymmetric information among the participants in the supply chain and consumers, and the advantages and disadvantages of the major types of traceability system.

2.1. Food Traceability System

In this dissertation, we focus on the traceability system of the products, which associates the materials, the origin of the product, its processing history and the distribution and location after delivery. There are various definitions of the traceability in food supply chain, with emphasis on different aspects of the system. The International Organization for Standardization (ISO-22005: 2007) defines traceability as the ñability to follow the movement of a feed or food through specified stage(s) of production, processing and distribution.ò The E.U. adopts a similar definition, with the focus on the food and feed industries, that food traceability is ñthe ability to trace and follow a food, feed, food-producing animal or substance intended

[22] Beekman (2008) argues that in addition to the traceability of factors relating to consumersô health, ethical traceability is also important because consumers should be informed about ethical issues, such as animal welfare.

to be, or expected to be incorporated into a food or feed, through all stages of production, processing and distribution.ò[23] Both of the definitions highlight the ability to follow the materials and the information within one company or along the supply chain.

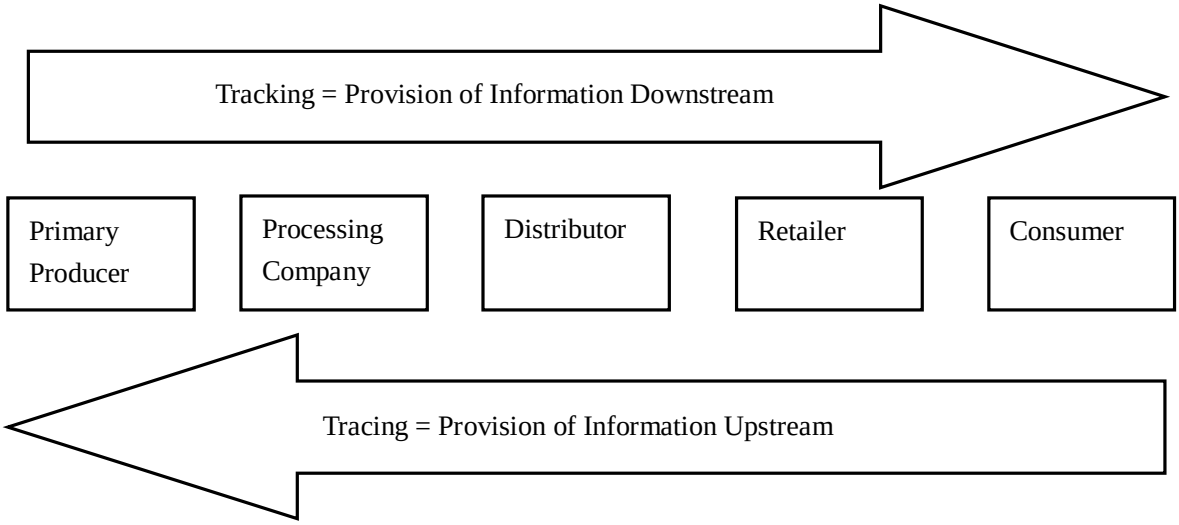
Moe (1998, pp.211) points out that the traceability system should be able to perform dual functions, *i.e.* ñtrack a product batch and its history through the whole, or part, of a production chain from harvest through transport, storage, processing, distribution and sales (hereafter called chain traceability) or internally in one of the steps in the chain for example the production step.ò The traceability system hence could be divided into two parts: the first one is the in-house traceability system, and the other is supply chain traceability system. Each supply chain participant should build internal record-keeping system, which is the foundation to their ability to trace and track along the supply chain. As a result, traceability should be linked to identities of the products, and also relate to the ñthe origin of materials and parts, product processing history, and the distribution and location of the product after delivery (Bertolini, Bevilacqua, and Massini, 2006, pp. 137).ò

Schwagele (2005) suggests that the traceability system is comprised of two key functions: one is the tracking; the other is tracing (See Figure 2.1). The function of tracking forward (top-down) pursues the product downstream along the supply chain, whereas the function of tracing backward (bottom-up) identifies the origins of the products used. A good traceability system should be able to perform both functions efficiently, in the sense that it records a broad amount of each traceable unitôs attributes, reaches far upstream or downstream in the supply chain, locate precisely the movements of the product, and access quickly the relevant information (Dabbene, Gay and Tortia, 2014). The effectiveness of traceability system mainly depends on the traceable unit, which is unseparated and minimum component of the supply chain and

[23] Regulation (EC) No 178/2002, para. 15.

uniquely identifiable within each system in which they are used.[24] The traceable unit has two important features. One is the uniqueness of the units, because the additional information must be linked to these units via the unique identification number, which is key to tracing and tracking the products (Storøy, Senneset, Forås, Olsen, Karlsen, and Frederiksen, 2008). Another one is the granularity, which reflects the levels and size of identifiable units that are handled (Karlsen, Dreyer, Olsen, and Elvevoll, 2012).[25]

Figure 2.1 Tracking and Tracing along the Food Chain



Sources: Schwagele (2005)

To properly perform such functions, a food traceability system should consist of four components in general: the product identification, data to trace, product routing, and traceability tools (Regattieri, Gamberi and Manzini, 2007). The first step involves

[24] The concept is first proposed by Kim, Fox, and Gruninger (1995), who define the traceable resource unit as ña homogeneous collection of one resource class that is used/consumed/produced/released by a primitive activity in a finite, non-zero quantity of that resource class.ò

[25] Karlsen, Dreyer, Olsen, and Elvevoll (2012) defined granularity as a quantity ñdetermined by the size of a traceable unit and the number of the smallest traceable units necessary to make up the traceable unit at a specific granularity level.ò

identification of the physical and mechanical properties of the product. The second relates to transfer the product characteristics to manageable data. The third record the product life along the supply chain, including how the product is produced, moved and stored. Finally, various technical solutions are applied to achieve well management of the data.

2.2. Benefits and Costs of Establishing Food Traceability System

Extensive economic analysis has been devoted to discussing how traceability system could function as the safeguard for food safety. The mechanism through which traceability system improves food safety is worth investigating, as Resende-Filho and Hurley (2012) have pointed out that traceability system does not directly improve food safety as Pathogen Reduction and HACCP. The literature suggests that the traceability system accumulates valuable information along the supply chain, which is important for business operators to make efficient decision.[26] Generally speaking the sellers along the supply chain enjoy information advantages about their own products. For one thing, the quality of food is usually uncertain and sometimes it is difficult to detect quality.[27] Based on the classification of search, experience and credence goods, Caswell and Mojduszka (1996) argue that government interventions are needed for the latter two types of goods, for instance the food safety and nutrition, because the

[26] Of course, traditional direct investigation also could improve food safety. Starbird (2005) develops a principle-agent model, where sellers are agent and buyers are principle, who uses the inspection policy to monitor the agent sellers imposes sanctions when product failure is found. He proposes that investigations will improve food safety when the internal failure costs are high.

[27] As a result of such difficulties, the market becomes more integrated. Hennessy (1996) suggests that when costs of identifying market goods are high, firms carry out vertical integration, which to some extent transfers the information system along the supply chain to the in-house information system. Similarly Lyon (1998) argues that due to the requirement of a ñcoordinated systemsò approach to food production, the food industry in E.U. expected a substitution of vertical integration of the business operators in spot markets.

information provided by the market are under the optimal level.[28]

For another, due to long supply chain (including producing, processing, packing, distributing, and retailing, etc.), it is highly likely that buyers have little knowledge about their upstream and downstream firms, let alone the quality of their production. Such asymmetric information could make market contracts inefficient as it is extremely hard for firms to select counter parties. As a result, suppliers tend to provide materials and ingredients with lower quality, *i.e.* they suffer from the problem of moral hazard. Anticipating such behaviors, the down-stream participants will pay less, which further drives away those high-quality suppliers. The market will be at a bad equilibrium as the result of adverse selection. Hölmstrom (1979) develops a general principal-agent framework and shows that the additional information principal accumulates generate value to the supply chain, and the society.

Traceability system has comparative advantages in mitigating asymmetric information and solving the problem of adverse selection and moral hazard (Sykuta, 2005).[29] Hobbs (2004) summarizes the benefits brought about by traceability system based on the time horizon when they function. First, *ex post* traceability system could facilitate reactions to the crisis that have revealed. Operators and public regulators are able to trace back to the sources of contaminations and effectively recall those contaminated products. In addition, the traceability system provides evidence to the private litigation that seeking civil compensation. For one thing, without such information, it is difficult for plaintiffs to sue the actual culpable, as it is difficult to prove the

[28] Carriquiry and Babcock (2007) argue that considering the heterogeneity in the inherent quality of agricultural outputs, traceability system can only increase the probability that a product has a claimed attribute.

[29] The literature has identified two approaches to overcome asymmetric information in supply chains: first, *ex ante* investment in product quality to overcome adverse selection problem, second, market incentives to induce producers to improve product quality and safety.

causality. On the other, traceability is important for allocation of liabilities of the food crisis, which actually shifts liabilities to upstream firms compared to the situation without such system where downstream firms could pay the majority of the compensation (Pouliot and Sumner, 2008). The exact identification of the liability internalizes the negative externality of the contaminated food, which, *ex ante*, provides appropriate incentives for operators to supply safe food.

Finally, *ex ante* the system reduces consumersô searching and verifying costs. The labeling on the product provides information on the ingredients and its origin, which are important to some consumers with particular needs, for example, these food allergic consumers. As a result, the traceability system increases the availability of information on quality of the product to the buyers, and hence the ability of buyers to select and negotiate with better suppliers. In addition, it also provides an important mechanism for consumers and operators to check if the information provided is accurate, which reduce the costs to verify. The survey conducted by Van Rijswijk and Frewer (2012) shows that consumers would like to obtain detailed background information about new and unfamiliar products, which they have little information before and 84% of participants regard traceability system as an important instrument to guarantee the authentication of products.

Without sufficient information, reputation becomes public goods, that is to say that individual firms could not exclude competitors to consume (damage) the reputation of a group of firms in a given industry due to limited information about the firm. Hence, individual firm will have incentives to over-consume the reputation, which generates significant negative externality to the industry. When food safety crisis breaks out, an entire industry can lose consumersô trusts and confidence thanks to one or a small proportion of firms. A case in point is the crisis of the dairy products in China. After *Sanlu Group* was revealed to add melamine into infant formula milk powder, the nation started to question the reliability of the dairy industry. As is reported by Qian, Guo, Wu and Guo (2010), the sales of milk powder, liquid milk and ice-cream are

reduced by 41%, 64%, 21% respectively.[30] Hence, providing information to the market through traceability system could reduce the nature of public goods in reputation *ex ante*. And the reputational system could distinguish the bad firms from the good ones, which provides incentives for participants along the supply chain to accumulate positive reputational asset, and maintain the quality of their products.

Empirical studies on consumersô behavior support the idea that they have a higher willingness to pay for products supplied with a labeling system. A significant proportion of the foodstuffsôattributes, including immune from diseases, such as BSE in cattle, radiation contamination, and organic, non-GM organisms, or free-range products, are credence attributes that are only verifiable with the traceability system (Buhr, 2003). For example, German consumers are willing to pay around 0.34 euro in addition for the products with ñquality and safetyò label in the meat sectors (Enneking, 2004). For consumers of the beef industry in the U.S., they also value the traceability of the origin-related credence attributes second to the direct food safety certification (Loureiro and Umberger, 2007).

To be specific, the reduction in asymmetric information generates several positive externalities and considerable benefits, including reduced costs of distribution systems, lower recall expenses, and increased sales of products with attributes that are difficult to discern, thanks to its valuable accumulated information (Storøy, Thakur, and Olsen, 2013). The operational performance of the firm could be improved if the traceability system is integrated with the management of the supply chain. An effective traceability system conveys information about every participant in the supply chain, which assists the management, production and minimization of waste and maximization use of materials. First, the information drew from the traceability

[30] Securities market also punishes firms adding melamine into milk powder. Dai, Kong and Wang (2013) find that investors reward those firms behave properly with significant positive abnormal return, while pull back fund from those misbehaving firms.

system can be used to manage and improve daily business processes. The strategic information, such as product quality information or ethical information is crucial to enforcement of the corporate strategies. Canavari, Centonze, Hingley and Spadoni (2010) shows that traceability system encourages the vertical coordination, which reduces the transaction costs devoted to solve uncertainties in the supply chain. The coordination with suppliers supports better plan of the supply, while with buyers allows a greater opportunities to sell the goods.

Second, traceability system is used as a competing strategy to preserve the identity of their products, which is employed to distinguish their products from the competitors (Golan, et al., 2004).[31] A number of foodstuffsô features are credence and experience qualities, for example, the health-related and process-related qualities, which are hard to tell before consumption. Consumers are shown to infer the quality of the food basing on descriptive features, such as color and fat content of meat, which are questionable (Grunert, 2005). The traceability system is shown to bring about positive benefits, and the safety and quality information provided is associated with the consumersô perceptions about the food safety, which consumers would like to pay high premium for. van Rijswijk, Frewer, Menozzi and Faioli (2008) conduct a survey in four European countries, and show that products being controlled or monitored through traceability system generate positive impacts on the trust and confidence of consumers on food safety. Though consumers seem to know little about the technical details of the traceability system, this effect is particularly significant when the origin of the product is disclosed, since consumers tend to buy products from a particular region (Kehagia, Chrysochou, Chryssochoidis, Krystallis and Linardakis, 2007).

[31] The experiment reported by Hobbs (2002) to measure the premium of consumers to the safe food using the method of ñwillingness to payò in Canada shows that consumers would like to pay highest premium to the combination of the traceability system and additional safety assurance and animal welfare system.

Third, the traceability system *ex ante* reduces the risks of the breakout of the crisis through identifying the suppliers and the quality of the ingredients and *ex post* facilitates the crisis management (Dupuy, Botta-Genoulaz and Guinet, 2005). The *ex ante* benefits could be particular large in some industries, for example, the perishable product, such as fruit and vegetables that go bad easily.[32] When a batch of raw materials or final products is found to be contaminated, through the traceability system, the producers could locate the source of the contaminated ingredients. All the products containing such materials or the materials in store could be handled properly either using external or internal recall system.

Though the literature identifies various benefits that could be brought about by the traceability system, Cheng and Simmons (1994) have warned that tracing and tracking function are costs adding, and the optimal degree of information depends on the costs of obtaining and maintaining information as the product moves in the supply chain. Complete traceability of the product from its origin to consumers is ideal, but the costs of carrying out such detailed system could be overwhelming, and the marginal benefits of the information could be trivial. Hence, it would be less cost-effective to improve the ñstringencyò of the traceability system monotonously considering its implementation costs. Carriquiry and Babcock (2007) model the ñstringencyò of the system as the precision of pinning down the failure along the supply chain and argue that efforts in traceability will increase as the consumersô abilities to tell the actual quality of the good improves. In addition, Resende-Filho and Hurley (2012) suggest that some of the alternative mechanisms, for example, could substitute for the traceability system. As a result, the optimal stringency of the traceability system depends on the level of joint incentives provided by the entire system.

[32] The research carried out by Van Rijswijk and Frewer (2012) confirms that nearly 80% of consumers surveyed agree that traceability system is most important for perishable goods.

2.3. Types of Food Traceability System

Golan et al. (2004) treat traceability as the synonym for the recordkeeping systems that are designed to track and trace the flow of product or product attributes in the supply chain or production process. The recordkeeping system of the history of the final product could be decomposed into two parts: one is the identification of the origin, components and authenticity of the foodstuff, the other is the record along the supply chain. And two major categories of traceability technologies are employed in these sub-recordkeeping systems, which includes identification tags and data loggers (Manzini and Accorsi, 2013). The identification tags assign an item with a unique code, and the data loggers are responsible for recording the data about the environmental conditions and profiles experienced by a product.

The origin and authenticity of a product could be identified using several advanced techniques. For example, Schwagele (2005) summarizes that the protein, fatty acids and DNA based methods are already used as species markers for animal materials. DNA analytical techniques, such as DNA sequence information, have been becoming increasingly popular as species identification. The most widely used target molecule in this area is the mitochondrial DNA (mtDNA), which has the advantages of rich available sequences and high genetic variability that make it possible for sophisticated primer design for sequencing. In addition, the stable isotope analyses are employed to assess the authenticity of the product. For instance, Ziegler, Osmond, Stichler and Trimborn (1976) propose to use the ratio of the stable isotopes of oxygen ($^{16}O/^{18}O$) and hydrogen ($^{1}H/^{2}H$) of water (H_2O) as the indicator of the environmental conditions, which could be used to trace the origin of the animal materials.

The labeling system for the origin of the product is the GIs system, which emphasizes the traditional knowledge and community ownership, rather than on the new creativity and individual ownership employed in the traditional intellectual property law. Currently, a labeling system is used to indicate the relationship between the foodstuff

and its geographical features that are common to certain commodities, such as rice and salt, in-processing products, such as coffee and tea, and final products, such as beverages, fruit marmalades, preserves, and sauces. GIs are granted with protection similar to trademark, and any damages, including using ñkindò, ñstyleò, ñimitationò and similar terms that could mislead consumers are forbidden. As a result, the consumers could distinguish the products from different regions that may have special characteristics they assign a higher value.

Regattieri and Manzini (2007) summarize three generations of instruments depending on the level of automation, which includes fundamentally alphanumerical code, bar code, and radio-frequency identification (RFID), the first two of which are labor-intensive and the last one is technology-intensive. The traceability system is emerged in the form of paper-based recoding system (Zhang, Zhang, Liu, Fu and Mu, 2010), which then evolves into the alphanumerical codes that are a sequence of numbers and letters giving the product a unique identity in the supply chain. The code is printed on a paper, which are placed on the product or the package. As the first generation of the techniques, the design of the system is quite simple and economical which reduces the technical barriers to wide application. However, the management of the system is labor-intensive because it needs manually writing and reading the codes, and inputting the data into the system. Hence it is very costly for those countries with high labor costs. The intensive involvement of labor leads to the high ratio of errors of recorded data.

The second generation of the technology depends on the bar code, which substitutes the stage of manually inputting the data with a semi-automatic reading machine.[33] However, the disadvantage of the technique is that the bar should be positioned to the reader, which has a particular zone for reading. To position the product, it usually

[33] A typical bar code is the Quick Response Codes, which are a type of two-dimensional barcode that can be read using reading devices.

needs human intervention, which still becomes a significant barrier for wide application if the labor costs are high. A more serious problem is the stability of the system. Peets (2009) documents an annual reduction of light transmission by 9% over a year period, which is ascribed to surface contamination. The possible damages of the bar could result in unreadable results of the product, which could fail to make accurate record for some of the products.

The third generation of the technology is the RFID system, which realizes complete automation of the process.[34] Thanks to the rapid advancement of the information technology, especially the Internet and the related hardware and software, it is economically feasible to install these logistics management and monitoring system. According to Costa et al. (2013), such system consists of a RFID tag, which could be either passive or active, a reader that gathers information, a database used to store the information. The tag, usually called the transponder, is consisted of an integrated circuit microchip, which has the ability to respond to the electromagnetic waves transmitted from the readers. With its ability to track signals and store data, RFID is helping business world, not only the agricultural industry, to revolutionize their supply chain management (Taghaboni-Dutta and Velthouse, 2006). Using the unique Using the Electronic Product Code imbedded in the RFID tag, operators could pinpoint where each item is at any point in time in the supply-chain.

The system has several insurmountable advantages compared with previous generations. It completely omits the manual control and increases the versatility of operational and logistic contexts, in addition to its long-servicing life and changeable shape (Sarac, Absi and Dauzère-Pérès, 2010). The RFID tag is read by radio contact, which omits the direct ñline-of-sightò contact that employed in the previous

[34] The industrial standard, for example, Electronic Product Code standard, makes it possible for information exchange between different firms, which leads to more efficient supply chain management (Ruiz-Garcia and Lunadei, 2011).

generation. Hence, a reader is capable of reading hundreds of RFID tags simultaneously leading to a significant reduction in required time of processing. In addition, the use of wireless microchips to create readable tag, which is more difficult to damage compared to code, will make the process completely automatic and without any manual intervention. It significantly saves the labor costs and reduces errors during the record process (Sahin, Dallery, and Gershwin, 2002).

But it also has obviously disadvantages in high technical barriers and the high average costs, which is a real concern for applications in developing countries. According to Peets (2009), the costs of labels and tags range from 0.23 euro to 0.51 euro, and the costs of interrogator (reader) range from 65 euro to 332 euro. Regattieri and Manzini (2007) report a case study on the cost relating to building a RFID system for the Italian cheese Parmigiano Reggiano. The average costs of the RFID system per piece of the cheese (standard weight equals 35 kg per piece) are 2.39 euro, which is around 0.0682 cents per kilo of the cheese. The wide application of the RFID system for Parmigiano Reggiano depends on that production is in bulk size, which reduces the average costs of the system.

Another problem with the wide application of the RFID system is that a significant proportion of firms have built its internal traceability systems, which are incompatible with the systems employed in the downstream operators. The situation reduces the efficiency of the data transfer. If the operators in the supply chain adopt a uniform system or systems with similar technical criteria that makes data transferable across different operators, the benefits of the system are sure to increase, which will lead to more firms to adopt the system. Storøy, Thakur, and Olsen (2013) introduce the TraceFood Framework, a joint collaboration of many EU-funded projects, to improve the coordination among the participants. The Framework has already been used to guide some pilot studies in the seafood and mineral water sectors, and shown to improve the performance of the participants.

Finally, concerns have been raised towards the threats to privacy by these tracing technologies. The information collected by the RFID system is likely to be assessed by other business entities or public agencies, which could learn about consumersô buying behaviors (Taghaboni-Dutta and Velthouse, 2006). The threat to the privacy is most obvious if a global registration system is created where every purchase action is linked to a credit card or bank card number, which ultimately will lead to its owners. The information generated by such system will be of great value to both private and public entities. An international organization, Consumers Against Supermarket Privacy Invasion and Numbering, has already started to oppose the applications of the RFID system.

2.4. Summary

This part reviews the literature on the traceability system focusing on its relationship with the food safety. It is widely recognized that the problem of asymmetric information makes it impossible for the market to supply safe food. The traceability systems gather information about product attributes and provides standardized information system on locations, which increase the availability of the decisional information. Consumers are shown to assign positive value to the additional information and see traceability system as an important instrument to guarantee the authentication of products. With the traceability system, reputation could function to distinguish the different operators, which would seem to be homogenous without sufficient information. The third generation of the traceability, the RFID system achieves, is shown to achieve complete automation and high efficiency in dealing with recording the product information, and improve the management of the supply chain.

3. Legislations on Food Safety and Traceability in European Union

In this section, we review and discuss the European food safety regulations in general and food traceability system in specific, which provide the foundation and guidance to the subsequent discussions on food safety and traceability regulations in China. The European food industry is the second largest (after metal) in the manufacturing industry, and an important component of the Internal Market. The sustainable development of the industry is both crucial for the health of the consumers and also the economy. Lyton (1998) argues that regulation of food safety is associated with two general economic conditions: one is the degree of fragmentation; the other is the relative anonymity of the individual operator in the food supply chain. The traditional moral accountability system of food safety is derived from the industrial structure filled with unfragmented and acquainted suppliers. However, due to technological advancement and international trade, highly specialized atomic producers located in a prolonged supply chain bring about huge changes the traditional system of food production and significant risks to food safety.

Before 1990s, the regulation of food industry was not successful, which is directed to promote free movement of foodstuffs throughout the internal market (Ugland and Veggeland, 2006). The legislations are consequently linked to the common agricultural policy, which emphasizes the free movement of goods, the increased agricultural productivity, the living standard for the agricultural community, the stabilization of the markets, the supply security and reasonable price level, which pays no attention to the issue of food safety and public health (Ockenden and Franklin, 1995). However, the focus of the regulation changed drastically to the assurance of food safety thereafter due to the BSE crisis. In 1997, the European Commission published a Green Paper on food law laying down the general principles of the food

safety regulation.[35] The 2000 White Paper on Food Safety[36] also explicitly articulated that highest standards of food safety should be the key policy priority for the Commission. Vos (2000) summarizes the four important principles created to guide the subsequent reform: first, the absolute priority of the consumer health protection, second, science-based decision models, third, transparent scientific advice and regulatory decisions, and finally, all food sectors and participants throughout the supply-chain should pursue food safety. Hence, the highest requirements of food safety call for that every operator of the supply chain is assessed and risks to consumer health related to raw materials, farming practices and food processing activities should be monitor, and should be applied to all the food no matter where they are produced.

To achieve this end, General Food Law (Regulation (EC) No. 178/2002, henceforth GFL) is enacted in 2002, and tries to establish a science-based framework and ñcomprehensive and integrated approach to food safetyò,[37] which promotes the upgrade of the industry to a coordinated one based on vertical integration. The GFL is not an encompassing code covering all the details of food safety regulation, but provides the basis for the supply of protection of human health and the consumersô interests in relation to food, while taking into consideration of the diversity in the supply of food including traditional products (van der Meulen and Freriks, 2006). The rest of this section is arranged as follows: Subsection 3.1. reviews the history of European food law. Subsection 3.2. discusses the GFL and the general institutions of food safety. Section 3.3. looks into the legislations and practices of protection of the labeling for the productsô origins, *i.e.* GIs. Section 3.4. is devoted specially to the legislations and practices of the tractability system in the supply chain.

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[35] COM(97) 176 final.

[36] COM (1999) 719 final.

[37] Regulation (EC) No. 178/2002, para. (11).

3.1. The Evolution of European Food Law

Since the Treaty of Rome in 1957, which established the European Economic Community, the European legislation regarding food safety is greatly evolved. Along with the consolidation of the role of the Community, the issue of food safety has reached a good level of consistency in 2000s, with a clear regulatory framework and guidance policy (Goodburn, 2001). Generally speaking, the history of European food law can be framed into three main phases prior to the promulgation of the FSL that characterized the Communitarian regulation in the food sector ((Alemanno, 2007). The first one is characterized first by the creation of standards for vertical specific type of product, then a more horizontal approach (van der Meulen, 2013). The second goes from the enactment of the Single European Act (1986) until the outbreak of BSE disease (1997). The third extends until the promulgation of FSL, during which the E.U. institutions took stock of the difficulties encountered in managing the BSE cases and worked intensively for the presentation of a European food law.

3.1.1. Stage One: 1957-1985

The 1957 Treaty was not made any direct reference to a food regulation. In fact, the regulation of the sector benefits from the indirect side effect of the efforts made to eliminate trade barriers arising from different legal systems in different member states, with the objective to implement an internal market (Alemanno, 2007). The basic principles on which to base this goal were four: the free movement of labor, the free movement of services, the free movement of capital and the free movement of goods. The latter gave the major contribution to the creation of a common framework for food regulation (van der Meulen, 2013).

According to Article 2, the Community task was to establish ña common market and progressively approximating the economic policies of Member Statesò. Moreover, Article 3 stipulates that the main activities of the Community include the ñelimination,

as between member states, of customs duties and of quantitative restrictions on the import and export of goods, and of all other measures having equivalent effectò (Goodburn, 2001). According to Article 30, all these types of obstacles to the common internal market are prohibited between member states. But it was expected the exclusion of all those constraints by member states in relation to ñpublic morality, public policy or public security; the protection of health and life of humans, animal or plantsò (Jukes, 1988). Another important reference through which the Community has legislated on food concerns the Article 100, regarding the harmonisation of laws, necessary for the proper functioning of the internal market. In fact, many national food legislation were considered an obstacle to the single market of foodstuff (Alemanno 2007).

The primary objective of the regulation of foodstuff in this period was purely economic: the free movement of goods within the Community. During this period the consumerôs health was still overshadowed (Leibovitch, 2007). In fact it was not made any priority to public heath or consumer protection until the adoption of the Single European Act (1986). Given the need to harmonize national legislations during the 1970s, compositional directives were still issued, which aims at creating standards for certain categories of foodstuff. These directives allowed the use of certain ingredients or prohibited the use of others for specific product categories such as chocolate, preserved milks, sugars, jams (Goodburn, 2001). Until mid-eighties, with the end of harmonizing specific areas of national legislations for the establishment of an internal market, more than 50 ñverticalò directives were issued (Alemanno, 2007). These vertical directives, that sought to define standards for specific food, are also called recipe, compositional or technical standards legislation (van der Meulen, 2013).

3.1.2. Stage Two: 1986-1997

Since 1985, the European Community began to turn form the goal of harmonizing all food regulations, in favor of a new approach based on the principle of mutual

recognition of laws between Member States. Was then introduced a common labeling system to illustrate differences in the composition and method of production of food products, with the purpose of giving consumers the chance to choice consciously (Leibovitch, 2007). The possibility of setting a common market through Harmonized product compositions failed for two basic reasons. The first was purely legal: the Article 94 of the Treaty required the unanimity rule to approve Directives. This mechanism caused a considerable difficulty in the EU decision-making, since even the obstruction of a single Member State determined the non-approval of the Directives.

The second was due to the culinary diversity between countries that sometimes made it impossible to reach common decisions. These difficulties led to the implementation of the a strategy of harmonization through the principle of mutual recognition (Alemanno, 2007). To subsitutte the vertical Directives for a more horizontal one needs the harmonization of national regulations, especially those relating to the foodstuff.[38] This Communication clarifies the main objectives of the foodstuff legislation: the protection of public health, provision of information to consumers and adequate official controls (Goodburn, 2001). From a legal perspecigve, the turning point was in 1979 with the *Cassis de Dijon Judgment*.[39] Under the German law, a drink to be considered liquor must contain a minimum of alcohol, which leads to the result that a German importer could not import a French liqueur because it contained less alcohol than the minimum threshold required by the German law. According to the European Court of Justice, the German law did not defend the public interest. In

[38] See Commission of the European Communities, 1985a. Communication on the completion of the internal market ñNew Approach to Technical Harmonisation and Standardsò, COM(85) 19 final; Commission of the European Communities, 1985b. Communication on Community legislation on foodstuffs, COM(85) 603 final.

[39] Judgment of the European Court of Justice, Case 120/78. ñRewe-Zentral AG v Bundesmonopolverwaltung für Branntweinò 1979, ECR.

addition, the German law prevented the free movement of goods. Was then introduced the principle of mutual recognition, which led to a horizontal approach to the legislation on food standards (Leibovitch, 2007). van der Meulen (2013) argues that this principle would have had the negative side effect of setting down quality standards in the Community and less rigid standards between Member States. However, according to the uropean Court of Justice, consumersô protection was ensured by the inclusion of additional information on the product label (Alemanno, 2007; van der Meulen, 2013).

Before the effective implementation of mutual recognition, it was necessary to switch from the unanimity voting system to the one requiring a qualified majority of votes. This happened in 1987 with the Single European Act, which came into force in 1987 (Article 95). During this period were enacted rules more focused towards common aspects of a wide range of foodstuffs, rather than on individual products (van der Meulen 2013). The goal was to avoid too much product-specific directives, to accelerate the achievement of the common market (Leibovitch, 2007). These framework directives, called ñNew Approach Directivesò, established the essential requirements in the area of additives, labeling, hygiene and official controls. These general Directives were intended to address the specific legislation of each Member State, which would be mutually recognized by the other States. Nevertheless, the economic objective of achieving the common market, realised in 1992 with the Maastricht Treaty, remained in the foreground at this stage. Yet there was no real ñcommon food policyò in Europe (Alemanno, 2007).

3.1.3. Stage Three: 1997-2002

The introduction of the principle of mutual recognition determined the emerging of numerous of outbreaks and food scares in the 1990s. This deeply undermined consumersô confidence in the effectiveness of the Community institutions (van der Meulen, 2013). It was becoming increasingly clear that the free movement of goods

could not always overcome the need to protect consumer health. Moreover, a uniform application of food safety regulation became an essential condition for the proper functioning of the internal market. It was therefore required a reorganization of the European food policy (Alemanno, 2007).

The BSE crisis in 1997 was not the first, nor the worst food safety crisis; but perhaps the one in which there was more evident a gap in the European legal and regulatory system. Among the food safety crisis occurred we remember the Spanish Toxic Oil Syndrome, which has sickened more than 20,000 people and caused more than 1,600 deaths between 1981 and 1994 (Gelpí et al., 2002). Other issues related to food safety have also affected outbreaks of animal diseases and scandals over fraudulent practices (van der Meulen, 2013). However, the BSE has represented the Year Zero for the European Community food regime (Chalmers 2003) and the first great European challenge in terms of international cooperation for food safety (van der Meulen, 2013). It is considered a significant event in the evolution of the European Community because it has contributed to rising awareness among citizens, and because it has highlighted the inadequacy of the regulation system regulation in ensuring a high level of public safety and consumer protection (Alemanno, 2007).

Before the BSE crisis, the Community has had some difficulties in the management of food safety and risk regulation. The latter requires both the development of Risk Assessment (associated with specific products or substances) and Risk Management (namely the decisional process to manage these risks). Risk Management was committed to three committees: the Scientific Committee on Foodstuffs, composed of independent scientists that assume the task of developing the Risk Assessment, the Standing Committee on Foodstuffs (StCF), composed of representatives of the Member States and the Advisory Committee on Foodstuffs (ACF), composed of representatives of different stakeholders. The task of StCF and ACF was processing of Risk Management in collaboration with the Commission (Joerges and Neyer, 1997).

In May 1997, it was launched the *Green Paper on the General Principles of Food Law* in the E.U.,[40] with the objective to create the basis for a reform in the food safety management at the Community level. According to the Communication, ñthe health protection in relation with the consumption of foodstuffs is to be an absolute priority at any time and not only something to be looked at in emergency situationsò. Six priorities were set and the concept of control over the entire food chain was introduced (ñfrom the stable to the tableò), which include all operators involved in the production and distribution of food.[41] The document pointed out that consumer health must have the same level of consideration in Community policies as had the Common Agricultural Policy and the free movement of goods.

Also in 1997 was enacted the *Consumer Health and Food Safety*[42], which laid the basis for a new approach to consumer health and food safety regulation, which put in the foreground food safety related to the strengthening of consumer protection, instead of the previous approach in which food security (especially with the CAP) was the priority (Vos, 2000). Three principles were established: the separation of responsibilities between legislation and scientific consultation, the separation of legislation responsibilities from that for inspection and the increased transparency and dissemination of information throughout the decision-making process and inspection procedures.[43] The concept of separation of assessment risk and risk management was introduced.

Three instruments were selected as essential to make effective consumer health policy: scientific advice, risk analysis, and risk control. The scientific advice obtained by the scientific committees, is identified as a basic element for the development of all

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[40] COM (1997) 176.

[41] COM (1997) 176.

[42] COM(1997) 183 final.

[43] COM (1997) 183 final.

regulatory activities. All activities of the scientific committees should be based on the excellence, independence and transparency. Regarding the risk analysis, it was underlined the importance of implementing risk assessment procedures to identify the priorities of the control and ensure that the entire food chain is taken into account. Another new element concerned control procedures and inspection which would be on the relief of national institutions, under the supervision Food and Veterinary Office (FVO) (Vos, 2000).

The new approach to food safety was absorbed also with the enactment of the Amsterdam Treaty, signed in October 1997. It was recognized the protection of public health and consumer protection as key objectives in the process of European integration. In particular, some articles pointed out the intention to not repeat the errors occurred during the BSE crisis (Vos, 2000). According to the Article 95 (3), ñthe health, safety, environmental protection and consumer protection, will take as a high level of protection, taking account in particular any new development based on scientific factsò.[44] According to this article, the harmonization policies should take account of the results obtained through scientific research. Furthermore, according to Article 152 ña high level of protection shall be ensuredò, compared with the previous version ñcontribute tooò, ñin the definition and the implementation all community policies and activitiesò. Finally, in Section 153 stipulates that ñin order to promote óthe interests of consumers and to ensure a high level of consumer protection, the Community shall contribute to protecting the health, safety and economic interests consumers, as well as to promoting their right to information, education and to organize themselves in order to safeguard their interests.ò

In the new approach and the measures implemented were not still enough to get back the confidence of European citizens. There were other alimentary scares, especially that concerning the dioxin contamination in Belgium which did increase the concern

[44] Consolidated Version Of The Treaty Establishing The European Community, 1997.

of consumers and increased the distrust in the industry and the in European authorities (Lok and Powell, 2005). Another critical element was that the set principles remained too general. In particular they did not establish clear rules with respect to risk management, the level of acceptable risk and the use of the precautionary principle in food regulation. There lack of a practical approach to the use of scientific information obtained (Vos, 2000). For this, the Director General of DG SANCO gave the charge to three scientists (James, Kemper and Pascale) to understand how to implement the most efficient system possible for providing advice in the most scietific Independent, transparent and excellent way. In 1999 a blueprint was provided for the creation of the European Food Authority. The Commission President Prodi immediately agreed and gave mandate for its implementation (Chalmers, 2003).

The White Paper on Food Safety intended to give the basis for a radical reform of food safety regulatory framework, stressing that the E.U. food policy must be built on high food safety standards, with the aim to protect and promote consumer health. It was reaffirmed that the production and consumption of food has a vital role in society and that economic, social and environmental issues should be also considered in the development of policy. In addition, emphasis was placed on the need for greater coordination and integration to achieve the objectives. Attached was provided a list of 84 legislative actions necessary for the implementation of the Food Safety Action Plan. A new element was represented by the creation of the European Food Authority, whose main roles will relate to the risk assessment and communication activities.[45] Providing scientific advice appears to be its main task, and the risk management is assigned to a different jurisdiction since the transfer of legislative powers to an independent body would undermine the democratic foundations of the Community. Another important innovation is that the Authority will make an important contribution concerning the ability to response to emergencies, both with the Rapid Alert System, and through collaboration with other scientific bodies and Member

[45] COM (2000) 719.

States[46]

3.2. General Food Law and Regulatory Framework

E.U. started to build a harmonized food safety policy partly due to the fact that segmented legislations and regulations enforced in the Member States have become significant threats to the integrity of the internal market (Jukes, 1995).[47] Due to non-tariff barriers, consumers in other countries could not purchase some of the products manufactured according to their national laws. A unified food law is consequently proposed, so that in some fundamental aspects, the Member States share the same requirements. GFL adopts a functional approach and tries to cover every step in the supply chain, ñfrom farm to forkò, comprehensively and integratedly to maintain food safety in E.U., the structure of which is shown in Figure 3.1.[48]

GFL is proposed to harmonize the general principles for legislation and the fundamental features of food safety across E.U. It as a result adopts a very broad scope regulating the safety of both food and feed for food-producing animals.[49] Van

[46] COM (2000) 1, Ch. 14.

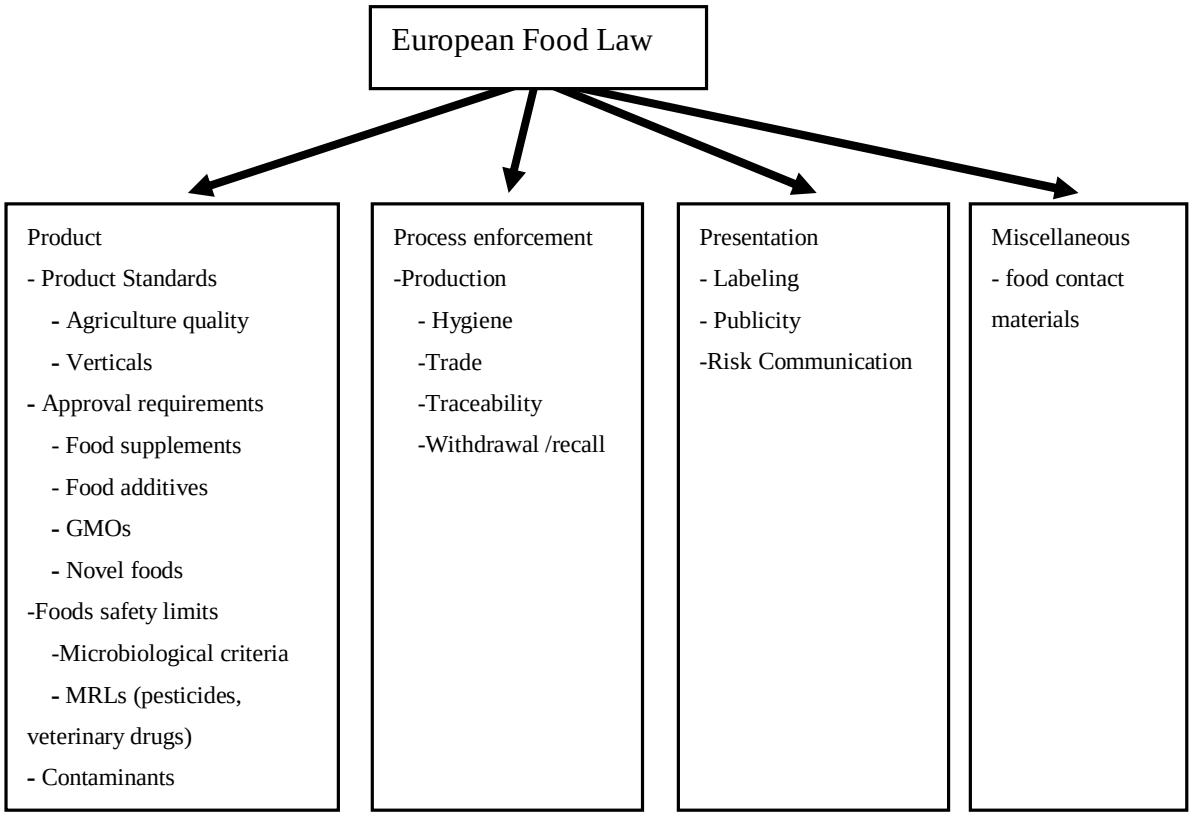
[47] The reform of the regulatory framework governing the food safety in E.U. is accelerated after the break out of the BSE crisis at the late 1990s (Szajkowska, 2009), which causes around 185,000 affected cases causes significant damages to its member states. The risk of BSE in Europe is now under control, thanks to the modern strategies of risk regulation, see http://www.efsa.europa.eu/en/press/news/120130f.htm.

[48] Article 17 (1) of EFL assigns responsibility to the ñfood and feed business operators at all stages of production, processing and distribution within the businesses under their control shall ensure that foods or feeds satisfy the requirements of food law which are relevant to their activities and shall verify that such requirements are met.ò

[49] According to Article 2 of GFL, ñfoodò is defined to include ñany substance or product, whether processed, partially processed or unprocessed, intended to be, or reasonably expected to be ingested by humans.ò Article 3(4) defines ñfeedò as ñany substance or product, including additives,

der Meulen (2009) points out that GFL only set up a general framework for food safety regulation, and subsequent legislations provide detail standards in accordance with the principles set up in GFL.

Figure 3.1 The Structure of European Food Law



Source: van der Meulen (2009)

For example, in the phase of primary production, the maximum levels of pesticide residues[50], the contaminants regarding Dioxins and Dioxin-like polychlorinated biphenyls[51], and the use of additives, flavorings and enzymes[52], are regulated. In

whether processed, partially processed or unprocessed, intended to be used for oral feeding to animalsò.

[50] Commission Recommendation 2006/26/EC.

[51] Commission Regulation (EC) No. 199/2006.

[52] Regulation (EC) No 1331/2008.

addition, rules are passed to regulate how the food safety should be guaranteed along the supply chain. During the transportation phase, the materials and articles in contact with food are regulated by the Regulation 1935/2004, and standards for hygiene package are stipulated by Regulations 852-854/2004. Finally, at the terminal sales, the labeling of foodstuffs[53] and the active and intelligent materials and articles extending the shelf-life or improving the state of the packaged food[54], are also regulated.

The primary goal stated by GFL is to prevent unsafe food, either a category of foods in general or a specific foodstuff, (van der Meulen, 2012), which is either injurious to health or unfit for human consumption, from being placed on the market.[55] In addition, ñon the marketò is defined quite broadly, which includes ñthe holding of food or feed for the purpose of sale, including offering for sale or any other form of transfer, whether free of charge or not, and the sale, distribution, and other forms of transfer themselvesò.[56] As a result, ñon the marketò does not only include market for final products, but also any form of trades in the food chain (Ratescu, 2010), including both transactions of inputs (e.g. animal feed) and outputs (e.g. primary production, processing, storage, transport and retail sale, etc.). To achieve the policy goal of safe food, GFL makes several innovative changes, including the risk analysis, precautionary principle and the independent agency EFSA, which are discussed subsequently.

3.2.1. Risk Analysis

The scientific instrument, through which the Community achieves the ends of safe food, is the risk analysis.[57] Hood et al. (2001) define risk regulation as the

[53] EU Regulation 1169/2011

[54] Regulation 1935/2004

[55] Regulation (EC) No 178/2002, art. 14(1).

[56] Regulation (EC) No 178/2002, art.3(8).

[57] Chapter Two of the White Paper on Food Safety identifies that risk analysis is the fundamental

ñgovernmental interference with market or social processes to control potential adverse consequences to healthò. Article 3(10) of GFL decomposes the concept into ña process consisting of three interconnected but separately assumed components: risk assessment, risk management, risk communication.ò[58] Figure 3.2 illustrates the relationship between these three components. The EFSA is responsible for the function of risk assessment and risk communication, the European Commission for risk management, and the Member States for enforcement. However, according to Cope et al. (2010), consumers are left out of the decision process, which compromises consumersô trust on public policies and the effectiveness of the communication strategy about the risk management.

The Community mandated the implementation of the HACCP system, a preventive approach that continuously monitors and controls the critical control points[59] to

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to food safety policy, see para. (12) COM (1999) 719 final.

[58] Article 3(11) of GFL defines risk assessment as ña scientifically based process consisting of four steps: hazard identification, hazard characterization, exposure assessment and risk characterizationò. Article 3(12) of GFL defines risk management as ñthe process, distinct from risk assessment, of weighing policy alternatives in consultation with interested parties, considering risk assessment and other legitimate factors, and, if need be, selecting appropriate prevention and control optionsò. And Article 3(13) of GFL defines risk communication as ñthe interactive exchange of information and opinions throughout the risk analysis process as regards hazards and risks, risk-related factors and risk perceptions, among risk assessors, risk managers, consumers, feed and food businesses, the academic community and other interested parties, including the explanation of risk assessment findings and the basis of risk management decisionsò.

[59] The Codex Alimentarius Committee has recommended that HACCP is the most effective system to maintain the supply of safe food. The Critical Control Point (CCP) is ñany point in the chain of food production from raw materials to finished product where the loss of control could result in unacceptable food safety riskò (Pierson and Corlett, 1992). It should be noticed that indicators measured easily should be selected to monitor CCPs, which is a more cost-effective

ensure that the products will meet the pre-set performance criteria, for all the food companies in E.U. in 2007 (Rotaru and Borda, 2007).[60] Such requirements are deemed to improved the quality supplied in E.U. Unnevehr and Jensen (1996) propose seven core principles to good performance of the HACCP program, which including assess hazard, identifying CCPs, setting up procedures to monitoring CCPs, preparing the corrective actions, building recordkeeping system and verification of the well function of the system. A well-functioned HACCP program facilitates rather than prevents the traditional inspective method because of the additional information collected and analyzed.

The system has significant advantages. It creates a systematic way to ensure safety, including corrective actions, recordkeeping and verification systems (Fortin, 2003). HACCP *ex ante* identifies critical points of controlling and monitoring in the production process, and changes the conventional end-point-testing methods of food safety to a preventive system emphasizing the quality of raw materials and processing steps (Ropkins and Beck, 2000). In addition, HACCP shift the responsibility of assuring safe good to the industry that should maintain continuous efforts in preventing and solving potential hazard problems. For example, hazard analysis should be employed in the HACCP process, which could either score the individual hazards conditioned on a maximum safe score or rank these potential hazards according to their importance in maintaining safe food. Finally, HACCP allows the traditional inspection methods to be more productive because new information and organization are constantly added to the production process. The recordkeeping systems require that food workers consistently implement traditional sanitary practices rather than perform a snapshot investigation.

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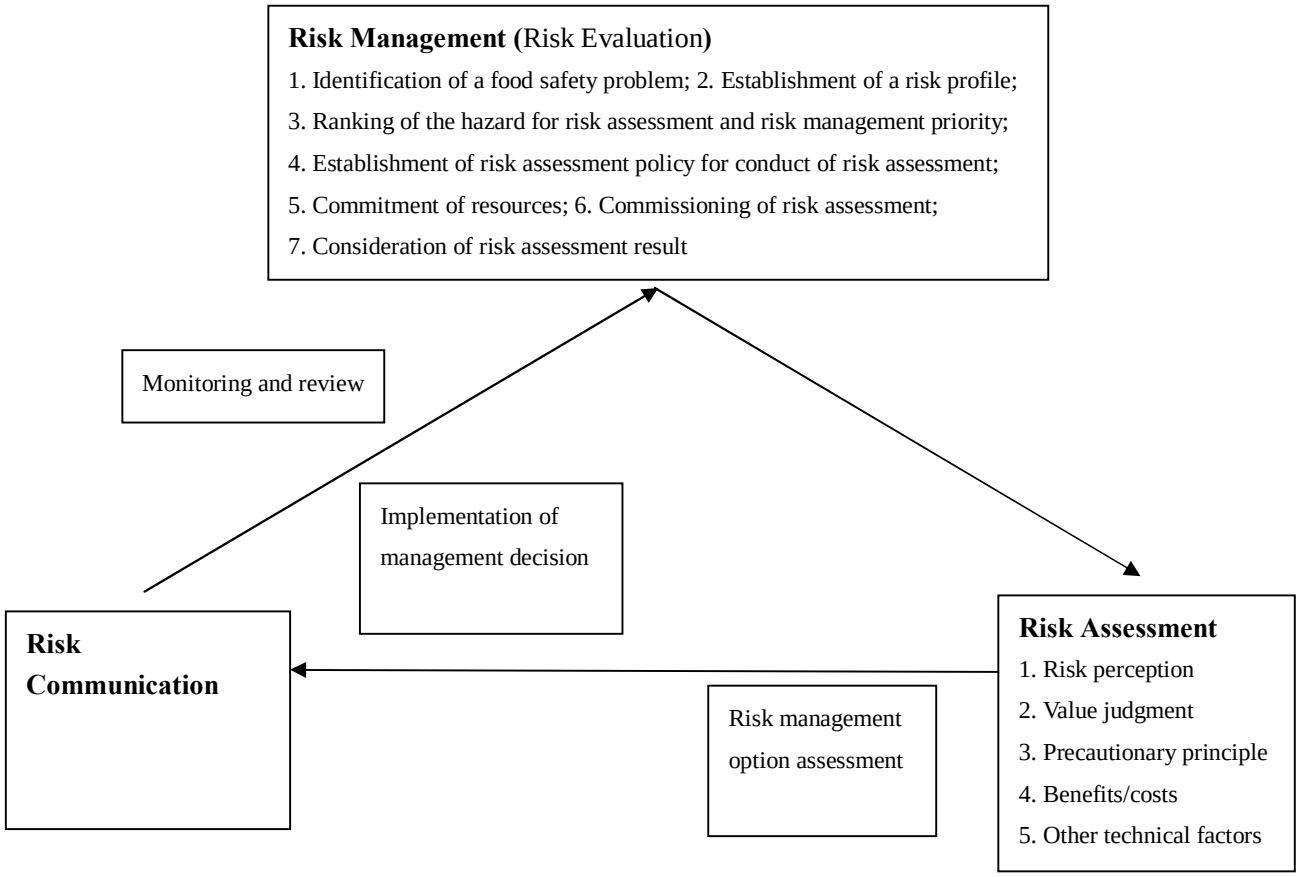
approach than sampling and testing.

[60] Both market and regulatory forces drive firms to adopt HACCP system to control food safety. Henson and Holt (2000) point out that market force including consumersô demand for reputations linked to certification or labeling and needs of improvements in efficiency.

Figure 3.2 The Risk Analysis Process



Sources: European Commission (2002)

3.2.2. Precautionary Principle

Another policy innovation of GFL is the precautionary principle, which provides a legitimate foundation for adopting protective regulatory measures without sufficient scientific evidence of the causes or the scale of damages.[61] The principle has been put forward in the Treaty on E.U. on environmental issues, which reflects that the Community placed the protection of human health over economic interests of the food industry.[62] The principle guides the risk management when the scientific risk

[61] Regulation (EC) No 178/2002, art.7.

[62] See Girela (2006) for an analysis of precautionary principle against the background of risk prevention.

assessment is inconclusive, as van der Meulen (2009:69) argues that ñthe most important function of the precautionary principle in EU food law is to ease the burden of proof for safeguard measures that require scientific justification through proof of a safety risk.ò According to Section 6.4 of the Communication from the Commission on the precautionary principle, when there is a positive list, the substance is deemed hazardous until the business community proves its safety, whereas such *a priori* approval procedures do not exist, then the burden of proof that the substance is risky lies on the consumer association, or public authorities.[63]

However, Recuerda (2008) argues that the principle has an inherent ambiguity due to the fact that it ñcan be interpreted in different ways, depending on the interpreterò. In reality, there is significant grey space between the situations where scientific information is sufficient and those where scientific information is insufficient. Such nature of the principle is prone to the political pressures and distorts the policy priorities (Majone, 2002). One position taken by the EC Court of Justice is that product standards established by Member States having negative effects on the free movement of goods within the Community and recalled proportional principle are not supported. [64]

Still the principle results in conflicts between Member States and the European Commission. For example, the Food Supplements Directive[65] provides the first harmonized Europe-wide regulation of food supplement, including vitamins and

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[63] COM(2000) 1 final.

[64] A much cited case ruled by European Court of Justices is the *Cassis de Dijon*, which established the principle of mutual recognition. The principle requires that ñproducts that have been lawfully produced and marketed in one of the Member States may not be kept out of other Member States on the grounds that they do not comply with the national rulesò (van der Meulen, 2009: 316).

[65] Directive 2002/46/EC.

minerals (LeCong, 2007). The Directive regulates the maximum intaking dosage, the advertisement, and the labeling and presentation of supplements. It also sets up a ñpositive listò, and only the substances on that list could be marketed. On one side, in U. K. the vitamin market was huge and loosely regulated. The new Directive would bring about billions of compliance costs to the domestic industries and small and medium enterprises are likely to go insolvency. The industry hence argued that the measure taken is not proportional to its ends.[66] On the other, the precautionary principle grant ample discretions to the Member States as the possible risks could be the ground for intervening measures. The Member States employ the precautionary principle to protect the interests of domestic industries, which could jeopardize the free movement of the goods within the community. Denmark employed a restriction on the import of vitamin enriched foodstuff due to the absence of the need in consuming such food (Harrington, 2006). However, the Commission rejected such contentions and ruled that the restriction is not in accord with the principle of proportionality. .

To curb the potential adverse effects of the application of precautionary principle on free movement of the goods within the internal market, the Community requires that the measures taken to be proportional to the risks and objective pursued.[67] To evaluate whether the directives and regulations are proportional to their ends, the Commission adopts the Regulatory Impact Assessment (RIA) to measure their impacts on economy, society and environment in one integrated framework. Hence, only regulatory measure, whose benefits exceed its costs or at least justify the costs,

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[66] On this ground several entities applied to the European Court of Justice for invalid of the Directive, See Joined Cases C-154/04 & C-155/04, Alliance for Natural Health v. Sec'y of State for Health.

[67] Proportionality means ñtailoring measures to the chosen level of protectionò, which requires that policy instruments should base on choices among various risk management options. Risk can rarely be reduced to zero, and a total ban of the product could not be a proportional response.

should be taken.[68] RIA also mandates that the proposed regulatory measures should be compared with the alternative measures, for example the *status quo* option, and the measures with the maximum net benefits should be taken. It is unnecessary to enforce restrictions of goods import when labeling requirements could satisfy food safety protections.

3.2.3. European Food Safety Authority and the Rapid Alert System

GFL creates an independent scientific body EFSA to provide ñscientific advice and scientific and technical support for the Communityøs legislation and policies in all fields which have a direct or indirect impact on food and feed safety.ò [69] Unlike the American Food and Drug Administration, EFSA has no decision-making powers, but employs scientific expert panels to produce scientific opinions and advice to support the decision functions.[70] It works with a precautionary approach, *i.e.* instead of assessing food risk after the breakout of crisis, Article 30 of GFL requires ESFA to identify any divergence in scientific opinions between interested parties, and to cooperate with these parties to resolve such divergences (Szajkowska, 2009). Consequently, the Authority supports the Community legislation with scientific evidence and its independence helps the Community to regain consumer trust in food safety.

EFSA functions more flexibly with a broad discretion to carry out scientific assessment on any matter that may have a direct or indirect effect on the safety of the food supply and could respond to requests from a variety of stakeholders, such as the national food authorities, the Member States and the E.U. Parliament (Alemanno,

[68] SEC(2009) 92.

[69] Regulation (EC) No 178/2002, art. 1.

[70] Szawlowska (2004) comments that conflicts existing between the scientific evidence provided by the national authority and the Community institutions, for instance those revealed in the case of *Commission v. France*, could be mitigated by ESFA to some extent.

2006). To effectively carry out its mission, EFSA is required to cooperate closely with the competent agencies in the Member States. The instrument that EFSA employs to assess risk is the Qualified Presumption of Safety (QPS), which is adopted as a harmonized approach to assess the notified biological agents across different EFSAôs Scientific Panels and Units (Leuschner et al., 2010).[71] A defined taxonomic group (e.g. genus or group of related species) are proposed and if there are no safety concerns for a particular strain, then it can be granted a QPS status. Those strains not considered suitable for QPS would be considered hazardous and remain subject to a full safety assessment (Barlow et al., 2007).

Besides *ex ante* estimates of the foods safety, Article 45(1) of Regulation 882/2004/EC also assigns the FVO of the Directorate General Health and Consumer protection, a part of the European Commissionôs civil service apparatus, the responsibility to make sure that food safety law is implemented and enforced. FVO inspects the nature and effectiveness of the national control systems and its capability of delivering the required standards, in addition to the on-the-spot checks of the places where the foodstuffs are produced or processed, such as farms, markets and food-processing entities, to make sure the *de facto* compliance. A crucial mechanism established in GFL to support achieving the goals articulated in GFL is the traceability system, which should make sure that ña food, feed, food-producing animal or substance intended to be, or expected to be incorporated into a food or feedò should be able to trace and track through all stages of production, processing and distribution.[72] The chain of traceability is comprehensive, including ñimport, from and including the primary production of a food, up to and including its storage, transport, sale or supply to the final consumer and, where relevant, the importation,

[71] The system is created to satisfy the need for a tool for setting priorities of approximately 100 species of microorganisms used in food/feed production within the risk assessment (Barlow et al., 2007).

[72] GFL, para. 15.

production, manufacture, storage, transport, distribution, sale and supply of feedò.[73]

Finally, the Regulation also provides tools for dealing with accidents and emergencies. Since 1979 a gentelmenôs Agreeement for the creation of a Rapid Alert System for Food and Feed had been already implemented, although it only manage emergency situations with respect to food, but not the feed. With regard to the emergency management, it is the duty of the Commission to put in place the necessary measures to deal with potential dangers for both Community origin and non-Eu products.[74] The crisis management gives the basis for the formulation of a ñGeneral Plan for food/feed crisisò and the creation of a crisis unit, where the risk can not be adequately managed with ordinary tools[75] The rest of the Section focuses on the traceability-related legislations, which include rules of the protection of geographical indicators that ensures the traceability of primary production and rules of traceability system in the supply-chain that ensures traceability of storage, transport, sale or supply to the final consumers.

3.3. Regulations of Geographical Indications

As the starting point of the supply chain, the origin place where the foodstuff is produced is crucial, which is determined by the geographical characteristics and the human factors. The GIs provide information for the original place of the product, which consumers rely on to make decisions. Products originated from protected GIs are estimated to generate a total sales around 14 billion Euros, with round 8.9 billion in Italy, 2.3 billion in France, 0.9 billion in Spain and 2.0 billion in Germany (Profeta, Balling, Schoene, and Wirsig, 2009). Due to its importance, E.U. has offered *sui generis* protection to GIs ever since 1992 (Moschini, Menapace and Pick, 2008).[76]

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[73] GFL, para. 16.

[74] Reg. 178/2008, arts. 53-54.

[75] Reg. 178/2008, arts. 55-57.

[76] Council Regulation (EEC) No 2081/92. The protection offered to GI in this regulation is quite

According to the latest version of Community Regulation on GIs[77], two types of GIs are protected. First, the ñdesignation of originò is used to indicate the ñname of a region, a specific place or, in exceptional cases, a countryò, which is used to describe an agricultural product or a foodstuff that ñoriginates in that region, specific place or country, or the quality or characteristics of which are essentially or exclusively due to a particular geographical environment with its inherent natural and human factors, and the production, processing and preparation of which take place in the defined geographical area.ò[78] In contrast, the ñgeographical indicationò is used to indicate the ñname of a region, a specific place or, in exceptional cases, a countryò, which is used to describe an agricultural product or a foodstuff that ñoriginates in that region, specific place or country, and possesses a specific quality, reputation or other characteristics attributable to that geographical origin, and the production and/or processing and/or preparation of which take place in the defined geographical area.ò[79] According to the definitions, ñdesignation of originò requires a stronger link between the natural environment of production and the quality of the product (Menapace and Moschini, 2012).

The implicit assumption that ñquality-geography nexusò exists underlies the GI protection.[80] European farmers are bound by a number of farming requirements including hygiene and safety standards, environmental regulations and societal

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strong and successful in granted number of GIs. Until 2006, there are over 700 registrations of designations of origin and geographical indications in the Community (Capelli, 2006).

[77] Council Regulation (EC) No. 510/2006.

[78] Council Regulation (EC) No. 510/2006, art. 2(1)(a).

[79] Council Regulation (EC) No. 510/2006, art. 2(1)(b).

[80] The ñquality-geography nexusò requires that a specific link between a productôs qualities and its geographical origin, which represents the main distinctive characteristic of any *sui generis* scheme (Menapace and Moschini, 2012).

concerns. They have to take due care in selecting pesticides and fertilizers and reduce the residues to below the minimum levels, and also follow the hygiene rules to prevent animals and plant diseases and provide proper welfare conditions to them. In addition to these qualitative, foodstuffs with particular GI protection should be produced in specific geographical area, which result in their exclusive characteristics.

As a result, the application of GI protection should spell out detailed technical specifications of production processes and the GI productôs attributes, which contribute to an important feature of the European regulation that the applicants for GIs are entitled to stipulate the particular requirements, including the designated geographical area, the specific elements of the product description or production method (Britton, 2004).[81] Yet, the regulation grants no protection to those names that become generic.[82] In addition, GIs are offered quite strong protection, similar to the trademark, that any direct and indirect infringement of the interests of protected GIs is prevented.[83] For example, even the use of ñstyleò, ñtypeò, ñmethodò, ñas produced inò, ñimitationò or similar in the name of the product not registered in the GI are prohibited. Finally, once a GI is registered, the application for a trade mark that is possible to mislead the consumers, for example including the geographical names, should be declined.[84] Only trademarks that are registered prior to the protected GIs could coexist with the GI.[85]

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[81] Council Regulation (EEC) No 2081/92, art. 4.

[82] Council Regulation (EEC) No 2081/92, art. 3. Council Regulation (EC) No. 510/2006, art. 3 explains the term ñgenericò, which means ñthe name of an agricultural product or a foodstuff which, although it relates to the place or the region where this product or foodstuff was originally produced or marketed, has become the common name of an agricultural product or a foodstuff in the Community.ò

[83] Council Regulation (EEC) No 2081/92, art. 13.

[84] Council Regulation (EEC) No 2081/92, art. 14.

[85] The conflict between GIs and trademarks is not rare. Coutrelis and Corre (2011) deliver a case

3.3.1. Why Protecting GIs?

The GI protection in E.U. serves to achieve three policy objectives: consumer protection, producer protection, and rural development (Rangnekar, 2004; Schwemer, 2012). For the first two policy objectives, GIs reduce the asymmetric information, which results in market failure, between the consumers and producers (Akerlof, 1970). The quality attributes of a producer are invisible to consumers unless the foodstuffs are consumed. Due to the fact that foodstuffs are experience goods, the suppliers have incentives to supply low-quality goods. Generally speaking, the system of trademark creates the reputational asset, which mitigates the problem of moral hazards (Klein and Leffle, 1981). The market assigns a higher price to the products of producers with renowned trademark, which provide incentives to the producers to preserve these intangible assets through constantly supplying high-quality product.

The protection of trademark is thoroughly investigated and relatively harmonized across countries, but the ongoing WTO negotiations still fails to achieve an agreement on GI. The trademark grants the owner the exclusive rights to use that mark in business. As a result, the consumers are assured that the products are of certain quality. Instead of capturing the firm-specific reputation as the trademark does, GIs capture the collective reputation. It represents a way in which a customer can locate the source or origin of a product, ñdenoting the quality and reputation of regionally distinct agricultural goods for purposes of product recognition on the international marketò (Murphy, 2003). Consumers do not have a preference for geography characteristics *per se*, but care about their abilities to determine the intrinsic quality of the product. However, a debated theoretical issue is the reason for coexistence of the

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note on the judgment on Bavaria NV v Bayerischer Brauerbund, where the collective owners of the protected GIs try to stop the trademarks including ñBavariaò from being used. To solve the case, the Court rules based on the time of registration and supports that the trademark registered prior to the registration of GIs are protected.

GIs and trademarks. Menapace and Moschini (2012) argue that GIs improve the ability of reputation to serve as a mechanism for quality assurance, even when a fully functioning trademark system has already been established.

The GI is essentially public goods to the member firms within the specific regions, *i.e.* the use of GIs by one member firm does not restrict its use by other firms and no member firms could be excluded from using GI. Due to this character, GIs are internally instable. On one hand, the success of the products coming from specific geographic areas lies on the collective reputation of the product. Winfree and McCluskey (2005) show that without traceability system, as more firms are entitled to the collective reputation, they are less incentivized and more likely to supply low-quality products. Such actions will generate excess return to a given firm, but reduces the premiums consumers would like to pay for GIs (Moschini, Menapace and Pick, 2008).

On the other, the member firms holding GIs usually have heterogeneous characteristics, for example, they own different resources and have diverse operating strategies. Consequently, they would like to influence the features of the GI to maximize its own profits, which could undermine the governance and joint profits of the GI (Dentoni, Menozzi and Capelli, 2012). For example, the external firms try to influence the standards of the ñProsciutto di Parmaò in Italy through acquisitions. Once they become insiders, they try to lobby the group to change its requirements to their own benefits. Hence, minimum standards are important to maintain the collective reputation.

It is likely that consumers will be misled without any labeling for GIs. Studies on the consumersô behavior reveal that they attach positive value to the characteristics connected to GIs, which differentiate these products from others. For example, Wirthgen (2005) reports that consumers would like to pay higher prices for the agricultural products from Elbe Valley in Western Germany due to the fact that the

region is famous for environment-friendly produced food. The survey carried out in Italy also shows that consumers are strongly favorable toward national or territorial identity and are willing to pay considerably price premiums for territorially certified food products (Scarpa, Philippidis and Spalatro, 2005).

For the third objective, GIs actually grant collective monopoly power to the firms located in the region, which will attract new generations to stay in rural areas.[86] The fixed investments involved in obtaining the protection of GIs deter the new entrants. In addition, GIs provide possibility to protect the indigenous peopleôs knowledge rather than the new creativity, an important component of cultural diversity, which gains no attention from the modern trademark system (Rangnekar, 2004). Finally, those products are usually land-based and are supplied by small and medium enterprises, which have low income level and no advantages compared to the massive production. Younger generations, who are fond of lifestyle in cosmopolitans, lack incentives staying at rural regions. Hence, the monopoly power makes it possible for these firms to charge rent embedded in the appellation, leading to attractive life in rural area. The empirical studies carried out by Agostino and Trivieri (2014) confirm the positive role of GIs on revenue and show that the quality wines with GIs are associated with higher value and their abilities to enter into new markets are improved.

3.3.2. International Debate and the New Council Regulation

One of the most important international agreements regulating GIs is the TRIPS in the WTO, the Article 22 to 24 of which are dedicated to the issues related to geographical indicators, and set the minimum standards for international protection to avoid usage

[86] Mérel and Sexton (2012) show that producers have incentives to supply products with excess quality and set the standards above the social-optimal level, because for GIs the market is competitive, the producers could not restrict the quantity supplied to increase their net profits. Hence, the technical requirements serve as a limit and reduces the quantity supplied.

of marketing strategy that misleads consumers.[87] It defines GIs to ñidentify a good as originating in the territory of a Member, or a region or locality in that territory, where a given quality, reputation or other characteristic of the good is essentially attributable to its geographical originò.[88] The protection is limited to the place of origin where the product comes from, but does not include the human factors (Echols, 2003). For example, the local soil or mould is a determinant of a special taste, texture, or color of a foodstuff. Due to its limitation as the coordination efforts, the enforcement of the agreement is left to the Member States, which should establish mechanisms that enable interested parties to untruthful and misleading uses of GIs (Heald, 1996). In addition, the wine and spirits are given a higher level of protection than other agricultural products, which are specifically dealt with by the Article 23 (Gutierrez, 2005).[89] TRIPs create a forum to solve the disputes among Member States, but GIs are still among the most important disputed topic, which fails to achieve significant progress during the last years.

Although there are mutual agreements among Member States of WTO on protection of GIs, there are divergences on the issue how should GIs be protected. The U.S. is

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[87] According to Montén (2005), GIs are not protected as a subgroup of Intellectual Property prior to the TRIPs agreement. The Doha Declaration made by WTO in November, 2001 explicitly regarded GIs as the solution to the problems of rural regions, which suffer from population loss and economic decline, see WTO, Ministerial Declaration of 14 November, 2001 (Doha Declaration), para. 13, see http://www.wto.org/english/thewto_e/minist_e/min01_e/mindecl_e.htm (last access Jan., 2014).

[88] TRIPs, art. 22 (1).

[89] TRIPs, art. 23(1) lays out that to prevent infringement, the ground that the public is misled need not be proved, but the article entirely prohibits geographical indications on ñwines not originating in the place indicated by the geographical indication... even where the true origin of the goods is indicated or the geographical Indication is used in translation or accompanied by expressions such as ókindô, ótypeô, óstyleô, óimitationô, or the likeò.

the leading opponent to the European approach, and counter for placing the GI with equal protection of the trademark, because the protection of GIs is in conflict with the trademark system supported by U.S., which emphasize the new creativity. It adopts a ñcertification marksò approach to regulate the GIs, where the certifying entity, instead of the producer, owns the certification marks.[90] The U.S. has gained significant advantages in trademark system, and it would be a danger for the owners of trademarks, who invest to promote and build the reputation of the trademark, to lose its exclusive rights to a GI. Unlike the European policy of linking GIs to certification and quality and boosting rural economy, the U.S. links GIs to property rights, which takes priority. A grandfather clause, the Article 24(5) in favor of trademarks has been planted into the TRIPs agreement, granting the previous trademarks the superiority over the later registered GIs (Montén, 2005).[91] Based on this article, U.S. initiated a dispute on the Article 14 of the Council Regulation 2081/92 that allows the co-existence of a later GI with an earlier registered trademark in 1999 (Handler, 2006).

Those geographic names or signs, which are primarily geographically descriptive and hence unregistrable as trademarks or collective marks, can be registered as

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[90] A certification mark is ñany word, name, symbol, or device used by a party or parties other than the owner of the mark to certify some aspect of the third partiesôgoods/services.ò See Certification Mark, Glossary, U.S. Patent and Trademark Office, http://www.uspto.gov/main/glossary/index.html#c.

[91] The Article 24 (5) reads ñWhere a trademark has been applied for or registered in good faith, or where rights to a trademark have been acquired through use in good faith either:

(a) before the date of application of these provisions in that Member as defined in Part VI; or

(b) before the geographical indication is protected in its country of origin;

measures adopted to implement this Section shall not prejudice eligibility for or the validity of the registration of a trademark, or the right to use a trademark, on the basis that such a trademark is identical with, or similar to, a geographical indication.ò

certification marks (USPTO, 2006). Such marks ensure that the products come from a particular place, which fails to lay down additional quality specifications that form the production process and the GI productôs attributes. Unlike trademark protection, which generally limits new entrants to the market, the certification mark allows free entry if the producer fulfills all the specifications for certification (Marette, Clemens and Babcock, 2008). Unlike the reliance on public intervention in Europe, the certifying organization will devote resources to policing the mark-holders and investigating infringements. Due to these differences, the American firms are less dependent on the certification marks to protect their reputations. For example, Marette et al. (2008) report that in Europe, there are 155 registered GIs for cheeses, while in the U.S., there are 21 certification marks for cheeses linked to geographic origin, of which 16 are for European cheeses.

Due to the international pressure, especially the judgment made by the WTO panel that EU regulations violated the equivalence and reciprocity conditions with respect to the availability of protection for GIs (Marette et al., 2008), E.U. modified its previous position, and published a new regulation on GIs, Council Regulation (EC) No 510/2006 (*GI Regulation 2006*). The new regulation makes important changes in the process of application. Previously non-European stakeholders are required to involve their national governments insofar as application and objection procedures of GIs, whereas the Member States are bound by the regulation to handle their citizensô applications, which discriminates the non-European stakeholders because of their heavier burdens in using the procedure. The *GI Regulation 2006* permits stakeholders to apply and object a GI either directly from the third country or via its government.[92]

However, the new regulations still maintains its previous positions that GIs are offered extensive protection. Article 13(1) of *GI Regulation 2006* provides exclusive rights to GIs and prevents them against ñ1) any direct or indirect commercial use; 2)

[92] Council Regulation (EC) No 510/2006, Articles 5(9).

any misuse, imitation, or evocation; 3) any other false or misleading indication as to the provenance, origin, nature or essential qualities; 4) any other practice liable to mislead the consumers.ò In contrast, according to TRIPs, such protection should only be extended to wines and spirits. For example, it permits the use of the word ñstyleò or ñtypeò in combination with a GI, as long as consumers are not misled and there is no unfair competition. In addition, the registration of GIs is only prevented if a reputational and renowned trademark has been registered for a long time and the registration of GIs will obviously mislead the consumers and undermine the function of the trademark.[93] If not, or the registration of the trademark incurred nullity for technical reasons[94], GIs can be registered and coexistences are allowed. After a GI has been legally registered, any application for a trademark of a comparable product should be rejected. Finally, the enforcement of the GI protection is led by public authorities, which is in contrast to the American private enforcement schemes based on trademark system. The Member States is mandated to designate one or more competent authorities to verify that operators adhere to the specifications.[95] The use of registered names under specific legislation on wines and spirits are also conducted as a part of the official control of the E.U. food law for other products. In case of GIs relating to a geographical area in a third country, the public authorities from third country should take the responsibility.

In 2008, the Commission published a Green Paper on agricultural quality, which aims at promoting the ability of European farmers to satisfy the consumersô demands.[96]

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[93] Council Regulation (EC) No 510/2006, Articles 3(4).

[94] Council Regulation (EC) No 510/2006, Articles 14(2).

[95] Council Regulation (EC) No 510/2006, Articles 11(1)

[96] There are several more specific goals, including improving communication between farmers and buyers and consumers on product qualities, increasing the coherence of EU agricultural product quality policy, and reducing complexities for farmers and producers, and consumers, see Communication from the Commission to the European Parliament, the Council, the European

The key to such policy is the quality of the product.[97] Besides price and quantity, consumers also concern hygiene and food safety, health and nutritional value, and societal and environmental issues. The measures of quality control can be divided in two ways: one is certification-type schemes, the other is baseline criteria. The baseline criteria set the minimum requirements of the food production and are enforced by the Community, whereas the certification type contributes to the differentiation of the foodstuffs and mitigates the asymmetric information between consumers and farmers, which the Community still finds the major problem.[98] GIs are selected as an important policy instrument to support the high quality of European agricultural products and discussed thoroughly in the accompanied impact assessment. The further investment in GIs is directed to Community-level communication to make these symbols better known, because consumers in third countries and Internal Market are less informed about the GIs labels.[99]

3.4. Regulations of Traceability in the Supply Chain

The fundamental regulation of traceability system in the supply chain is stipulated by the Article 18 of GFL. The system gains special attention due to the outbreaks of diseases in animals that could be transmitted to human-beings and the presence of

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Economic and Social Committee and the Committee of Regions on Agricultural Product Quality Policy Impact Assessment Report, SEC(2009) 670.

[97] Quality ñis about meeting consumer expectationsò, see Green Paper on Agricultural Product Quality: Product Standards, Farming Requirements and Quality Schemes, COM(2008) 641 final, pp.4.

[98] See Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of Regions on Agricultural Product Quality Policy Impact Assessment Report, SEC(2009) 670, pp.14.

[99] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of Regions on Agricultural Product Quality Policy Impact Assessment Report, SEC(2009) 670.

chemicals above acceptable limits in feeds and foodstuffs, for example the BSE and the dioxin contamination in Dutch potato peels. Consequently, the beginning of GFL recognizes that the function of the Internal Market could be jeopardized without the traceability system.[100] It requires that ñthe 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.ò[101] The requirements are quite extensive as the transportation and storage are included, but they are not extended to the regions outside E.U., that is to say final goods exported are not covered. Finally, the final products should be properly labeled, so that consumers are provided with enough information for decisions.[102] The implementation of traceability system is ensured by regular inspections of the FVO of the European Commission,

This is the first time in Europe that a legal obligation is created for food business operators to identify the suppliers and direct buyers of their food or feed.[103] The traceability system will make sure that the operators collect the information about the entities which they buy raw materials from, and they supply products to.[104] The information is crucial in facilitating targeted withdrawal and recall of food with controllable costs, providing consumers with accurate information and maintaining their confidence, and facilitating risk assessment by control authorities.[105] This is

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[100] GFL, para. 10.

[101] GFL, art. 18 (1).

[102] GFL, art. 18 (4).

[103] Guidance on the Implementation of Articles 11, 12, 14, 17, 18, 19 and 20 of Regulation (EC) N 178/2002 on General Food Law, pp. 17. The obligation created by GFL went into effect on 1 Jan., 2005 (Folinas, Manikas and Manos, 2006).

[104] GFL, art. 18 (2), (3).

[105] Guidance on the Implementation of Articles 11, 12, 14, 17, 18, 19 and 20 of Regulation (EC) N 178/2002 on General Food Law, pp. 16.

particularly important when a crisis needs to act promptly.

Another important component of the traceability system is how the products are presented when they are sold to final consumers, who concern the traceability system because they could make decisions conditioned on the information provided by such system.[106] The Regulation No 1169/2011 governs the labeling issue, which brings together the set of rules on food labeling, presentation and advertising in a single legislative text.[107] It is the food operators that are responsible for ensuring that the accurate and clear information is provided to the consumers.[108] The system guarantees that consumers will make informed decisions, which will not be misled by the inaccurate information.

There is both mandatory and voluntary labeling of information to consumers. The information included as mandatory are those related to the appropriate use of a food and for consumers to make choices that suit their individual dietary needs. For example, some of the meatsôgeographical origins, including beef and beef products, swine, sheep, goat and poultrymeat, are required to be disclosed on the labels of the products. In addition, the nutrition information concerns the energy and certain nutrients in foods should also be provided, which is regarded as important instruments

[106] The information measures are important to achieve certain policy goals, for example the reduction in the rate of obesity in Europe (Mazzocchi, Traill, Shogren, 2009). The empirical studies carried out in Italy confirms that consumers care about the nutrition claims of the products, especially the people with excess weight and that are more likely to suffer from diet-related diseases (Banterle and Cavaliere, 2014).

[107] The label is defined as ñany tag, brand, mark, pictorial or other descriptive matter, written, printed, stenciled, marked, embossed or impressed on, or attached to the packaging or container of foodò, see Regulation No 1169/2011, art. 2(2)(i).

[108] Regulation No 1169/2011, art. 8(2).

to fight against overweight and obesity.[109] Finally, substances of products causing allergies or intolerances should be labeled.[110] To make the list clear, the Article 9 of Regulation No 1169/2011 explicitly mandates the 12 most important items that should be provided on the labels or packaging.

In addition, the entire Chapter V of the regulation is devoted to the issue of voluntary labeling of relevant information. Generally speaking, the voluntary disclosure of information is welcomed by the Commission, especially the nutrition information that may contribute to consumersô appropriate decisions. However, several studies also show that there are strong incentives for operators to voluntarily provide information in order to compromise the integrity of the mandatory disclosure and mislead consumers.[111] As a result, the main requirements of the regulation are to set the standardized format for the voluntary disclosure, which makes them comparable to that of mandatory disclosure of information.[112]

In addition to these two general regulations on traceability system in the supply chain and labeling of the product, the Community has also enforced other regulations specific to the particular industries. The rest of the subsection discusses three of them, the regulation of the beef industry, the fishery and aquaculture products and the GM food and feed.

3.4.1. Traceability System of the Beef Industry

Due to the BSE crisis, the beef industry in E.U. has experienced significant instability,

[109] White Paper on A Strategy for Europe on Nutrition, Overweight and Obesity Related Health Issues, COM(2007) 279 final.

[110] Regulation (EC) No 1760/2000, art. 21. The substances and products that cause allergies and intolerance are identified in the Annex II.

[111] Regulation No 1169/2011, para. (47).

[112] Regulation No 1169/2011, art. 36 and art. 37.

which calls for an improvement in the transparency of the producing and marketing process. The Commission as a result concluded that the implementation of Directive 92/102/EEC is not satisfactory, which leads to the new regulation on traceability and labeling system for the beef products in 2000.[113] The new regulation stipulates mandatory requirements that should be in force from 1 Jan., 2002, for each Member States, which should establish a system for identification and registration of bovine animals, *i.e.* it requires detailed requirements on the traceability and labeling of the beef and beef products circulated in E.U.

The system of identifications and registrations of bovine animals consists of ear tags, database, animal passports and individual registers kept on every holding.[114] Such system is applied to the animals imported from the third country, and imported animals should be assigned ear tags within 20 days after they passed the checks laid down in Directive 91/496/EEC.[115] A passport is issued to the animal within 14 days of its birth, or, in the case of animals imported from third countries, within 14 days of its re-identification by the Member States, to record the movement of the animal.[116] And the keepers of the animals are assigned with the responsibility to maintain relevant information of the animals concerning the origin, identification and the destination of animals and report to the electronic data base ñall movements to and from the holding and all births and deaths of animals on the holdingò[117].

However, the traceability system is not as well-functioned as expected due to technical limits. Shanahan et al. (2009) reports that operators adopt barcode scanners to record the identification number of the bovine in Ireland. Because the barcode on

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[113] See Regulation (EC) No 1760/2000.

[114] Regulation (EC) No 1760/2000, art. 3.

[115] Regulation (EC) No 1760/2000, art. 4 (3).

[116] Regulation (EC) No 1760/2000, art. 6 (1).

[117] Regulation (EC) No 1760/2000, art. 7 (1).

the ear tag could be unreadable, some of the data could only be recorded from the passport, which hence should be accompanied with the cattle along the movement. The Irish system of passport recording is proved to be vulnerable to fraudulent reporting. Some of the recorded information is transferred through postal services, which results in additional time lag of the mandatory information.

Another pillar stone of the regulation is labeling[118] of the beef and beef products, which mandates the information about the origin where the animals were born, fattened and slaughtered. The minimum information provided by the mandatory system includes a reference number linking to the original animal, the approval number of the slaughterhouse, and the approval number of the cutting house.[119] The voluntary disclosure of information through labeling is encouraged, provided that it does not negatively affect Community trade. The competent authorities should act to maintain that the label is clear and consumers are not misled by inaccurate information disclosed in the label.

3.4.2. Traceability System of the Fishery and Aquaculture Products

In 2001, a special regulation on the traceability and labeling of fishery and aquaculture products is issued by the Commission to provide consumers with detailed information.[120] The species, method of production, and the geographical origins (farming area) should be provided by means of labeling, packaging or a commercial document.[121] In addition, the traceability system is important for fishery industry

[118] Labeling means ñthe attachment of a label to an individual piece or pieces of meat or to their packaging material, or in the case of non-prewrapped products the supply of appropriate information in written and visible form to the consumer at the point of saleò, see Regulation (EC) No 1760/2000, art. 12.

[119] Regulation (EC) No 1760/2000, art. 13 (2).

[120] Regulation (EC) No 2065/2001.

[121] Regulation (EC) No 2065/2001, art. 8.

because E.U. employs it to achieve another policy goal to combat with illegal, IUU fishing, which the Council Regulation (EC) No 1005/2008 is directed against (Andre, 2014). IUU has been the most serious threats to the sustainable fishery and jeopardizes the Communityôs common policy, and the Community has established a certification scheme applied to all trade of fishery products within the Community.[122] Hence, the traceability system, especially the identification of the geographical origins, serves to ensure that the products sold follow the Community regulations, and cuts down the possible marketing channel for illegal fishery products.

Besides in Europe, the importance of labeling and traceability system is also recognized by international organizations, such as the Food and Agriculture Organization (FAO) of the United Nations. It also supports eco-labeling as an effective way to provide information to consumers and published the ôInternational Plan of Action to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishingõ in 2001 to guide the governmental fight against IUU. A key component of the action plan adopted so far is the mandatory recording of product data, which should be available for access through a traceability system (Borit and Olsen, 2012).

A European wide project, the TraceFish project, has been established to achieve an electronic traceability system in the supply chain for the industry. It is a voluntary system and lays down the technical details for such system. It requires that each unit of goods is labeled with a unique identification number, which the operators and transferor in the supply chain are responsible for recording and assigning. The TraceFish system collects several aspects of information on the products including fundamental information such as those on physical movement, specially required information such as those on the nature of the food and the condition of the production, and commercially desirable information such as product details (Denton, 2003). Such information is standardized and should be available if public authorities

[122] Council Regulation (EC) No 1005/2008, art. 12.

require in case of crisis.

3.4.3. Traceability System of the Genetically Modified Food and Feed

The regulation of the GM food and feed is a part of the general framework regulating the GM organisms, which are set out by the Directive 2001/18.[123] The Community adopts a process-oriented regulatory approach towards GM organisms due to its scientific uncertainty on environment, human, animal and plant health.[124] As a result, the precautionary principle is recalled to guide both the drafting and implementing of relevant regulations.[125] The burden of proof that the new product will not cause adverse effects on health and environment is born by the applicants (Anker and Grossman, 2009). A unique feature of the traceability system for GM organisms is the post-release monitoring plan, which establishes the traceability system after the products are sold. Such plan ensures that the assumptions underlying the proposed assessment are correct and unanticipated adverse effects on human health or the environment could be tracked.

To fulfill the goals of providing safe food, the Regulation 1829/2003 on GM food and feed is enacted to set out provisions for authorizing and labeling GM food and feed following the requirements of Directive 2001/18. The regulation has quite broad scope, which covers ñfood use, food containing or consisting of GMOs, and food produced from or containing ingredients produced from GMOs.ò[126] Similar to the

[123] Directive 2001/18/EC of the European Parliament and of the Council.

[124] The Community adopts a ñone door-one keyò principle to govern the authorization of GMOs marketing. The applicants much file a notification to the Member State, which includes the genral information about the GMO, the assessment of environmental risk, a plan for post-release monitoring, conditions for use and handling of the product, a summary of the dossier, and other information, see Directive 2001/18/EC, art. 6.

[125] Directive 2001/18/EC, para. (8).

[126] Regulation 1829/2003, art. 3.

regulation of GM organisms, GM food and feed could not be placed on the market without *ex ante* authorization of the competent authorities.[127] Usually EFSA will evaluate the risks and respond to the doubts raised by other Member States or the Commission.[128]

An additional regulation is in place, which specially builds a unified system to tract, trace and label the GM food and feed.[129] Yet such requirements are not applied to products, which contain ñadventitious or technically unavoidableò traces of authorized GM organisms in a proportion no higher than 0.9 per cent of the food ingredients (Anker and Grossman, 2009).[130] In such context, traceability is defined as ñ"the ability to trace GM organisms and products produced from GM organisms at all stages of their placing on the market through the production and distribution chainsò[131] The traceability of GM food and feed is realized via a unique identifier assigned to new products, which should be registered with the Commission.[132] In particular, suppliers of GM food and feed should ensure operators receiving the products information indicating the ingredients of the food and feed materials or additives that are produced from GM organisms, or that the product is produced from GM organisms.[133] Such information should be held for a period of five years for each transaction.

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[127] Regulation 1829/2003, art. 4.

[128] For regulating the risks in GMOs, separated competent authorities are responsible for risk management and risk assessment. For example, in the field of food safety, the risk management function is assumed by the Commission using the comitology procedures, whereas the risk assessment function is assigned to EFSA.

[129] Regulation 1830/2003.

[130] Regulation 1830/2003, art. 4(7).

[131] Regulation 1830/2003, art. 3(3).

[132] Regulation 1830/2003, art. 8.

[133] Regulation 1830/2003, art. 5.

To label the products containing GMOs, operators should ensure that words ñThis product contains genetically modified Organismsò or ñThis product contains genetically modified [name of organism(s)]ò should appear on the label of package or accompany the product for display.[134] In addition, special information about any characteristic or property which results in a food or feed different from its conventional counterpart regarding composition, nutritional value or effects, intentional use and health implications, plus any ethical or religious concerns, should be disclosed.[135]

3.4.4. Summary

The European legislation posits extensive traceability and labeling responsibility to food and feed industries.[136] The traceability system accumulates the information in the supply chain and facilitates the internal and external management of the production process. It is also the foundations to a well-functioned recall system, which could react promptly in case of crisis. The labeling system provides clear and accurate information about the products, which is crucial for the consumersô appropriate decisions. The regulatory system both mandates that certain information should be labeled and provides standardized format for voluntary labeling, which intends to protect the integrity of the mandatory disclosure system.

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[134] Regulation 1830/2003, art. 4 (6).

[135] Regulation 1830/2003, art. 13.

[136] The European regulation of traceability and labeling with respect to GM food and feed differs quite strongly from that in the U.S., where GM food and feed are not required to be labeled.

4. Food Safety Law and the New Food Safety Assurance System in China

Although the condition of food safety is improving, it still attracts significant attentions from the general public in China.[137] The State Council has devoted considerable resources in drafting and enforcing food safety regulations. Also the provincial efforts on improving local food safety conditions should not be ignored. Six provincial level governments that are regions with relatively higher income level, have already promulgated their local regulations on food safety, which include Beijing, Shanghai, Guangdong, Heilongjiang, Guizhou, and Zhejiang. They try to enforce regulatory standards higher than national ones to improve their consumersô confidence. For those poorer regions, the local government lacks of incentives and inputs to improve the condition of food safety (Holtkamp, Liu and McGuire, 2014).

The food safety problem in China has its unique features. After around thirty yearsô high growth, the issue of food security, *i.e.* the problem of providing enough food to its people, is solved in most regions in China, which makes it different from other developing countries that are struggling to feed its people.[138] According to the National Bureau of Statistics, the Engelôs coefficient, reflecting the proportion of income spent on food, drops significantly from 57.5% to 35.0% in urban area and

[137] In this dissertation, otherwise noted, we mainly discuss the conditions of food safety regulation in mainland China. The food safety regulation in Special Administrative Region could be quite different from that in mainland China. Wu et al. (2014) comment that Hong Kong is a famous ñfood paradiseò and has its own system of food safety regulation.

[138] Veeck, Yu and Burns (2010: 222) have commented on the changes of food safety in China over the past two decades, which changes ñfrom a predominantly state-regulated food system that was bounded by season, location and traditional taste to a much expanded food supply that offers larger quantity and variety year round and is increasingly exposed to global market forces.ò

from 67.7% to 37.7% in rural area between 1978 and 2013.[139] Prior to the repeated scandals of food safety, especially the melamine contamination of dairy products, the goals of public policies are set to support the food and feed industry. For example, some of the large enterprises are exempted from inspection because the regulators hope that their own quality control checks will function well. But the regulations change to emphasize the quality control system to guarantee the food safety recently (Pei, Tandon, Alldrick, Giorgi, Huang, Yang, 2011).

In addition, the problem also differs from that in E.U., which usually concerns about the problem originating from applications of new technologies, new crafts, and new materials to agriculture and food manufacturing. In contrast, the food safety problems in China are mainly concerned with the incidents related to microorganisms, toxic plants and animals, and chemical contamination, illegal food additives and contamination with environmental hazards.[140] Xue and Zhang (2013) collected data on 2387 incidents of acute food borne illnesses in public reports from 1999 to 2010, and find that microorganism contamination is the major cause for illness and man-made chemicals cause the most death.

This section aims at discussing the legislations and regulations on food safety in China, especially the new system established after the enactment of FSL in 2009. The

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[139] The data is retrieved from the Qilu Newspaper, available at http://www.qlwb.com.cn/2014/0225/90768.shtml. (Last access 20/01/2015, in Chinese)

[140] Four major sources of pollution are worth particular attention. First, some of the total diet studies show that the heavy metal intake levels, such as cadmium and lead, are considerably high (Chen, 2013). Second, there is overuse of pesticide in the agricultural production process, which increases 2.4 between 1990 and 2010 to reach over 17 million tons (Cai, 2013). Third, in the cattle industry, veterinary drugs are extensively used, which could result in high levels of resistance to antimicrobials (Jiang, Dong and Zhao, 2011). Finally, additives are widely used to extend product life and increase aesthetic appeals (Cheng, 2012).

repeated food safety scandals indicate that there could be some weakness within the regulatory framework in China. Hence, the first subsection is devoted to the review of the traditional system and its efficiencies. The second subsection discusses the food-safety related legislations and relevant regulatory agencies, which focuses on the differences made in the new system. The third one is particularly devoted to the regulatory innovation the risk assessment process. Finally, the fourth subsection gives a discussion on the new standards and self-regulation in the firm-level that change rapidly after FSL.

4.1. The Inefficient Food Safety Regulation prior to the Food Safety Law

4.1.1. Food Hygiene Law

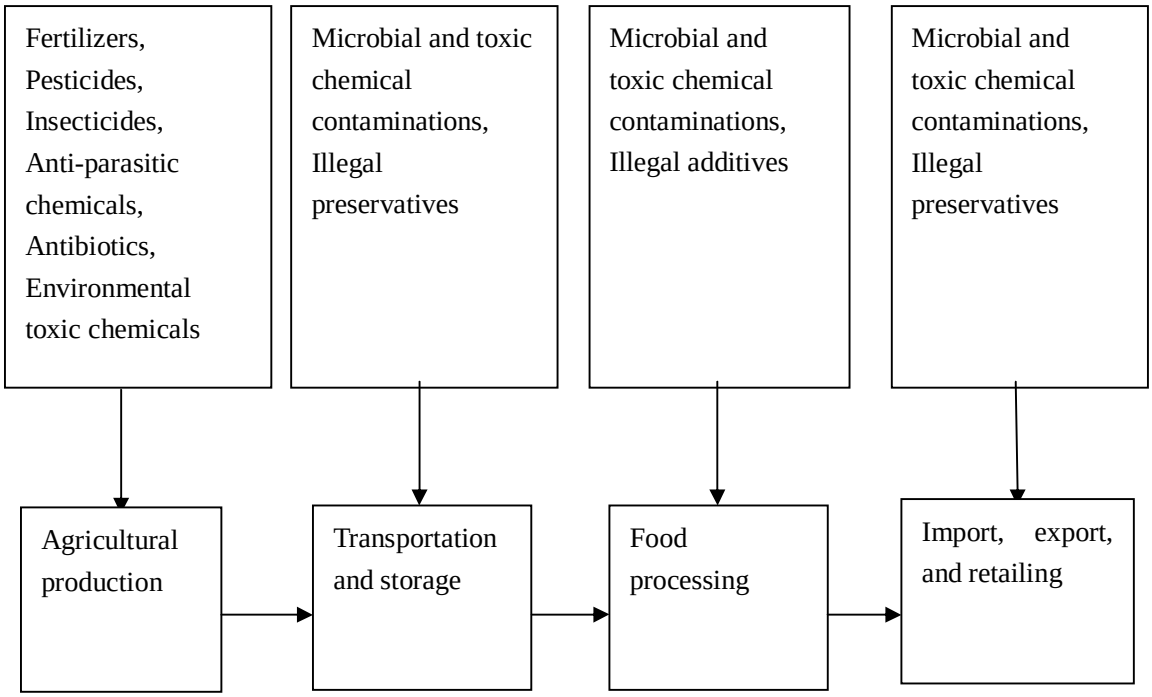
The traditional regulatory system of food safety is both horizontally and vertically divided. The regulation of the chain ñfrom farm to forkò is segmentedly assigned to different public agencies, which are responsible to the threats to food safety in specific phases of supply-chain as is shown in Figure 4.1. Hence, the legislations on food safety are drafted accordingly and the regulatory power is assigned to govern the business in different phases. The basic legal rules governing the food safety is the updated 1995 Food Hygiene Law (FHL), which was enacted in 1983 on trial. The FHL was quite general and only applied to the food production process, which excluded other parts of food supply chain, such as planting, breeding, storing and transporting process (Zhang, Liu and Yang, 2005).

In addition, the 1995 version of FHL designated the regulatory power to the MOH[141] and set forth the general standards for the content, additives, packages and manufacturing conditions of foodstuffs. However, the regulatory bodies are passive

[141] FHL, art. 3.

and lack of incentives to actively intervene in the food safety regulations (Li, 2009). The potential food safety risks are not analyzed, assessed and monitored, which leaves the daily regulations empty.

Figure 4.1 Possible Sources of Contamination in the Food Supply Chain



Sources: Lam et al. (2013)

Thirdly, the power to draft the food safety standards is exclusively delegated to the respective administrative departments on health under the State Council. These public agencies are short of resources to scientifically establish a complete food safety standard system covering all aspects of food productions, processing, circulations and food additives and feeds. As a result, regulatory vacuums are sure to exist. Finally, although civil, administrative and criminal liabilities are put in place to punish violations of the prescribed duties,[142] the administrative penalties dominate, which reflect the public-oriented food safety regulatory system. Due to that FHL was drafted

[142] FHL, art. 37-41.

two decades ago, the monetary penalty set for failure of sanitary standard was 5,000 RMB, which provided no deterrence to potential crimes.

4.1.2. Complementary Legislations and Regulatory Agencies

The FHL drafted nearly 20 years ago is designed to deal with the problems at that time, and falls short of providing sufficient protection to the consumers. Then China was still struggling to increase its food supply and the collective economies dominated. The SOEs produced most of the food and the demand was far exceeding the supply. In addition, because the revenue is collected by the state, producers and suppliers lacked incentives to use low-quality materials. Consequently, there was no need to add illegal additives to the foodstuff to improve the appearances or to extend the shelf lives. All these conditions are not met in the new millennium. The economic reform carried out in the last two decades significantly increases the share of private economy, which is highly driven by the incentives for higher profits. Also, the supply of the foodstuff is increased and now surpasses the demand, which makes the attractiveness and the shelf-life important.

Hence, two subsequent legislations are enacted to supplement the regulatory vacancies of FHL. The Agri-food Quality and Safety Law (AQSL, enacted in 2006) prescribes the quality and standards for the primary agricultural products.[143] The quality standards of origin area, producing process and packages are specified with detailed rules.[144] And the duty to regulate the primary production is explicitly assigned to the agencies at the county level.[145] Furthermore, the Agriculture Law (enacted in 2003) provides guidance to measures that should be taken to protect the food safety. It requires public agencies to build the regulatory system for agricultural

[143] AQSL,art. 2.

[144] AQSL, Chapter 3, 4, 5.

[145] AQSL,art. 3.

product standards and the procedures to inspect and test the product quality.[146] It especially requires that the illegal pesticides, veterinary medicine and feed additives should not be used in the production process.[147]

Thirdly, the Law of Standardization (enacted in 2003) set the broad requirements for public agencies to make the safety and hygiene standards for the design, production, inspection, packaging, storage, transportation process,[148] and the relevant standards for environmental protection and inspection.[149] Fourth, the Law of Product Quality (enacted in 2000) governs the general responsibilities of the producers and the retailers, which also imposes *ex post* liabilities to ensure food safety. The producers are responsible for the safety of their products and should label necessary information on the product.[150] At the same time, the retailers should scrutinize the authenticity of the product and make sure they are qualified.[151]

In accordance with the legal institutions, the regulatory duties are divided among various public agencies, which undermine the enforcement of the legal rules and lead to potential regulatory vacuum. At least the State Food and Drug Administration (SFDA), MOA, MOH, AQSIQ, MOC, State Administration of Industry and Commerce (SAIC), Ministry of Environmental Protection of the P.R.C. are responsible to monitoring the food production and transportation in the supply chain (Ni and Zeng, 2009). Each of these agencies is responsible for monitoring a particular part of the food production, transportation and retailing process. It is no wonder that the regulatory blind spots are quite common in the industry. For example, the *Sanlu*

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[146] Agriculture Law, art. 22.

[147] Agriculture Law, art. 25.

[148] Law of Standardization, art. 2(1) (2).

[149] Law of Standardization, art. 2(3).

[150] Law of Product Quality, art. 27.

[151] Law of Product Quality, art. 33.

scandal revealed the significant shortcomings of the segmented regulation: the quality of original milk should be monitored by the MOA, and the production process should be regulated by AQSIQ and MOH, while the retailing process should be supervised by the MOC, SAIC and the SFDA.

To make things worse, these public agencies are equal in the hierarchical ladder, which makes it difficult for these agencies to collaborate with each other. When a potential risk involves two or more nodes of the supply chain, the staffs of these agencies need to work together. Their equal position makes it difficult to decide the leadership among the temporary team. Furthermore, public agencies in foreign countries find it difficult to cooperate with Chinese agencies due to the complicated structure of food safety regulation. Czarnezki, Lin, and Carmeron (2012) report that the offices of American Food and Drug Authority in China have great troubles in communicating with the local government officials and the information collected from these agencies is difficult to interpret. Finally, if a food safety crisis breaks out, the public agencies will try to shift the responsibilities to others and it is hard to identify the exact spot of the regulatory failures. Consequently, the ambiguous *ex post* liability reduces their *ex ante* incentives to regulate effectively.

The highly unsafe food not only undermines the confidence of domestic consumers, it also leads to the loss of confidence in foreign markets.[152] After the *Sanlu* scandal, the domestic consumers stopped buying dairy products originated from China, and the imported products took around 90 percent in the market of infant milk powder with high value added. In addition, the concerns of food safety have become a barrier to the international trade. For example, the E.U. stopped imports of animals originating

[152] The export industry of the foodstuff grows rapidly and in 2013 the total food export reached 57.95 billion U.S. dollars, compared to 7.5 billion U.S. dollars exported in 1980. The data is retrieved from the website of the Department of the Commence of Zhejiang Province, see http://www.zcom.gov.cn/art/2014/3/25/art_1054_88535.html.

from China after finding high levels of veterinary medicines residues. In 2007, the U.S. found that the domestic dogs and cats were dying at unexpected high rate, which are ascribed to the contaminated adulterated ingredients of pet food imported from China (Thompson and Ying, 2007). To control the quality of the imported food, the Food and Drug Authority in the U.S. even opened three offices in China after 2008 to facilitate and improve the regulation of food safety in China (Czarnezki, Lin, and Carmeron, 2012).[153]

Noticing the severe damages that food safety scandals make both to the industries and to the images of the government, the State Council decided to reform and upgrade the regulatory system of food safety, which features with the enactment of FSL in 2009.[154] The next subsection is devoted to discussing of FSL and the consequent changes in the regulatory system.

[153] Due to the importance of export industry, the regulation of food exported changes more rapidly. Liu, Kerr and Hobbs (2012) report that the Chinese State Food and Drug Administration and the Chinese General Administration for Quality Supervision, Inspection and Quarantine respectively concluded two Memorandums of Agreement with the U.S. Department of Health and Human Services on 11 December 2007. The two institutions agree to provide information to the US Food and Drug Administration regarding the certification status of medical devices, finished drug products and active pharmaceutical ingredients.

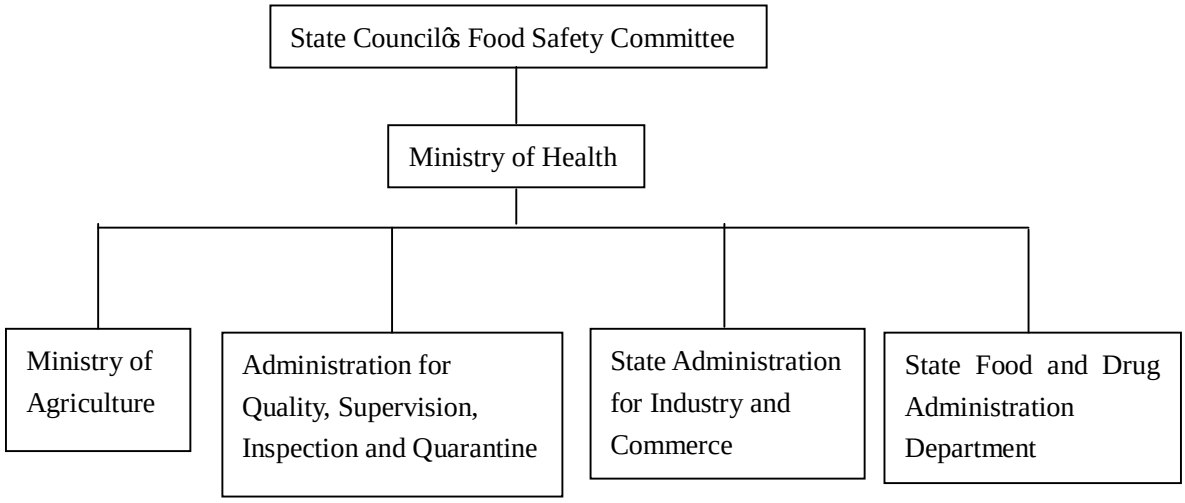
[154] Hong Kong regulates its food safety in a different manner from that of China, and FSL is only applied to mainland China. The most significant difference of food safety regulation in Hong Kong is that a unifying system with a high degree of centralization is in place (Wu et al., 2014). The Food and Health Bureau is in charge of assuring food safety, and The Agriculture, Fisheries and Conservation Department, the Food and Environmental Hygiene Department and the Government Laboratory are the executing agencies.

4.2. Food Safety Law and Regulatory Changes

4.2.1. Regulatory Innovations of FSL

Due to the obvious shortcomings of the traditional regulatory system and the repeated food safety crisis, the State Council decided to reform the regulatory system, and enacted the FSL in June 2009 after 5 years of drafting.[155] FSL streamlines and clarifies the allocations of the regulatory duties. Figure 4.2 shows the new regulatory structure. The State Councilôs Food Safety Committee leads the food safety management and makes national plans for food safety regulation. Various ministries carry out specific functions of food safety regulation. MOH coordinates the regulatory agencies and makes the food safety standards. MOA is responsible for regulating the edible agricultural products, and AQSIQ is responsible for supervision of food production and the export and import of foodstuffs, the SAIC supervises the retailing process of the foodstuffs, *i.e.* the domestic wholesale and retail of foodstuff sectors, and finally, the SFDA regulates the catering and restaurant services.

Figure 4.2 The Management Structure of Food Safety Control



Sources: Jia and Jukes (2013)

[155] The long process of passage of FSL is due to the fact that the issue of food safety is concerned with the multiple agencies, which tend to protect their interests during the legislative process.

In addition, FSL broadens the meaning of food safety regulation, which covers both the nodes in the supply chain and environment where the food is produced or processed.[156] This change is in accordance with the modern idea that food regulation should cover from ñfarm to fork.ò However, it is a great pity that the regulations of the food circulation are still segmented under the FSL, which are shared by the industrial and commercial departments. The State Administration for Industry and Commerce assumed the role to establish the regulatory framework and focuses on business entry, inspection of the stocks, the commitment of food quality, food unshelving and recalling and trader credit system (Wu and Zhu, 2014).

FSL explicitly assigns the duties to maintain safe food to the producers, who ranks first to assume the potential legal liabilities originated from unsafe food.[157] The retailers are also responsible to scrutinize the products sold and keep the marketing place sterilized. An innovative measure taken after FSL is the insurance for food safety liability, which first emerges in the Henan Province. The Peopleôs Insurance Company of China signs the insurance contracts with local farmers and sends expert teams to evaluate and monitor the safety risks. The measure shifts the *ex post* investigation forward, and provide *ex ante* external monitoring to guard food safety.[158] Additional to the general regulation of circulation system, special rules are promulgated to regulate the specific food sectors that are of particular importance or have high risk of food safety crisis. The supply of food in rural market, dairy products, illegal additives, edible oil and wine market is monitored specially.

Thirdly, it creates a food safety committee, the Food Safety Committee in State Council, which consists of high-rank government officials to coordinate the regulation

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[156] FSL, art. 27.

[157] FSL, art. 3.

[158] Available at http://news.xinhuanet.com/fortune/2014-12/23/c_127328629.htm (In Chinese).

of food safety and increase the centralization of the regulatory power.[159] FSL clarifies the individual responsibilities among different agencies. Although several other public agencies preserve the authority to regulate certain aspects of food safety, the MOH and its subdivision, the Food and Drug Administration, are allocated with the major responsibilities. The county and above level of administrations are responsible for executing these regulations and maintaining regional food safety issues.[160] The information is collected upstream along the hierarchical ladder with lower level administration reporting to higher level. FSL raises the transparency between the public and regulatory agencies hoping to reduce the potential loss of consumersô confidence due to lack of information (Balzano, 2012).

Fourthly, FSL requires that a national recall system of unsafe food should be established, which is deemed as one of the major improvements of FSL (Pagnattaro and Peirce, 2010).[161] The AQSIQ is responsible for coordinating the national recall actions. The recall system was first built in City of Beijing in 2002 on trial and a detailed national regulation, the *Regulations of Food Recall System*, was issued by AQSIQ in 2007, which provides three levels of recalling actions depending on the severity of the food safety. The producers and retailers should report and recall their products when evidence has shown that the foodstuffs are harmful or have potential harmful effects on the health of consumers.[162] The regulators are consigned with the power to investigate and collect samples of the foodstuff, which should be evaluated scientifically to determine if they need to be recalled.[163]

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[159] FSL, art. 4.

[160] FSL, art. 11.

[161] FSL, art. 53.

[162] Wang (2009) criticized that the scope of the recall system is too restricted, and the dealers should assume the responsibility to recall the unsafe foodstuffs.

[163] FSL, art. 72.

4.2.2. Unsolved Inefficiencies of FSL

Although FSL makes significant improvements in food safety regulation, several of the obvious shortcomings still exist. First, with clearer definition of regulatory responsibilities of each public agency, a number of agencies are involved in the food safety regulation, which surely will lead to gaps and overlaps among duties of different regulatory agencies (Jia and Jukes, 2013). Although the MOH is deemed to play the predominant role in protecting food safety, it has to cooperate with various departments under the State Council, which have their own authorities over particular phases of food chain.[164]

In addition, the enforcement of the regulations is weak.[165] On one hand, the enforcement of the food safety regulation is delegated to the local administrations, which could lack of proper incentives and appropriate expertise to regulate.[166] Some of these authorities have no independent food safety regulatory departments. In contrast, the workload of these departments is huge, as there are around 103 laws, 201 regulations and 124 rules to enforce (Wu and Zhu, 2014). Moreover, since the local officials are evaluated with the economic criteria, such as GDP and the strict

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[164] See art. 5 of the *Regulation on the Implementation of the Food Safety Law of the People's Republic of China* (promulgated by the Standing Committee of the National People's Congress, July, 2009).

[165] The weak enforcement of regulations is a prevalent problem in China, see Van Rooij (2006) on enforcement of environmental law.

[166] The Article 5 of the FSL requires that the local government at or above the county level shall assume the responsibility for the food safety administration and regulation within its own administrative region. They should lead, organize and coordinate the task of food safety regulation, establish a sound whole-process food safety supervision and administration mechanism, deal with food safety emergencies, improve and execute the food safety accountability system, and evaluate the performances of the relevant departments.

regulations of food safety would damage the GDP growth, there are high agency costs in the public enforcement of food safety regulation, and the condition is not satisfactory.

On the other, the private enforcement of food safety law through court system is also weak. Rarely are cases concerning criminal cases of food safety incidents are heard and the *Criminal Law* is usually the basis of the judgments.[167] And the civil penalties for breaking the FSL are relatively low. The administrative fines amount from five to ten times of the value of illegal products, and some of the criminals could be sentenced to death as exemplified in the *Sanlu* case.[168] But those consumers harmed have difficulty in sorting civil compensations based on tort via litigation.[169] Two factors contribute to the inefficient court system, on one hand, the local protectionism is severe and the regional governments are prone to influence the local courts not to accept such cases because local enterprises are the source of the GDP growth, which is an important indicator for political evaluation (Liu, 2010). On the other, even the courts hear such cases, the civil compensation could be limited because the potential harms could be long term and difficult to prove at the court.

Third, the labeling system of foodstuffs is not well established. Article 42 of FSL explicitly requires that the package of foodstuffs should include labels, yet the mandatory information is limited. The most notorious information not required is the label for GM food, which is hard for consumers to tell if the products they buy are GM organisms or not (Chen and Deng, 2004). This situation significantly

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[167] The Articles 140, 143 and 144 of *Criminal Law* regulate the food safety crime.

[168] FSL, art. 84, 85.

[169] FSL, art. 96. FSL assigns the litigation rights to aggrieved consumers to seek compensations for damages up to 10 times of the product price, but it is less cost-effective for consumers to travel to the place where the producers reside and seeking compensation (Sun, 2010).

compromises the freedom of consumersôchoice.[170]

Fourth, a survey carried out by Yang et al. (2012) shows that the regulatory inputs in low level authorities are insufficient. Though 68.4% of the municipalities had specialized agro-food quality and safety supervision authorities, the average staff number was less than eight, who are responsible for regulations of the plant, livestock and aquatic product safety. Only 14.6% of the townships set up Agro-Food Safety Public Services, which takes the responsibility to train farmers for the recent development in agro-food safety, the agro-food control technology, and inspect and assure that safety control measures are implemented. At the same time, only slightly more than half of the municipalities had specialized agricultural law enforcement authorities. The data shows that food safety laws and regulations are weakly enforced in grass-roots levels.

Finally, although end product testing is crucial for assessing the food safety risks, it could only reveal the risks after it is on the market (Walker, Pritchard and Forsythe, 2003). An end-testing oriented regulatory system is hard to prevent potential harms and trace or recall the risky products. Hence, a preventive approach is also needed to safeguard consumers and makes predictions on the trend of food safety.

4.3. Regulatory Instrument Risk Analysis

The most important policy innovation of FSL is the systematic risk analysis system, which is already employed as an effective tool to protect the safe food in E.U. and comprises of 3 elements: risk assessment, risk management, and risk communication.[171] The risk-based food safety regulation adds a scientific dimension

[170] This could be changed because the recent proposed amendment of FSL mentions the introduction of labeling system of GMOs, available at http://www.npc.gov.cn/npc/xinwen/lfgz/2014-12/23/content_1890674.htm (In Chinese).

[171] International institutions, such as FAO of the United Nations, World Health Organization

into the administrative regulation and improves the expertise employed in decision-making (Liu et al., 2013). The risk analysis system also facilitates the adoption of formal procedures such as the cost-benefit analysis and allows public agencies to weigh the regulatory costs and expected benefits (Balzano, 2012). Until 2012, a national food risk analysis and monitoring system has been built, which includes one national, 31 provincial, 226 municipal, 50 county-level institutions. The system regularly assesses and monitors 154 indicators for pesticide and veterinary medicine residues, heavy metals, biotoxin, illegal food additives, and food-borne pathogenic organisms, etc.[172] There are around 6300 laboratories with around 64 thousand stuffs specialized in examinations and investigations.[173]

4.3.1. Risk Assessment

Risk assessment is a structured scientific process mainly consisting of hazard identification, exposure assessment, hazard characterization, and risk characterization (Hoornstra and Notermans, 2001).[174] There are qualitative and quantitative approaches to carry out the risk assessment depending on the data availability. The function of risk assessment is originally assumed by the National Expert Committee for Food Safety Risk Assessment and its Secretariat in the MOH, which was created immediately after the enactment of FSL. In 2011, a new independent agency, the Chinaôs National Center for Food Safety Risk Assessment (NCFSRA), absorbs the staff of the Committee[175] to create a national risk assessments system, which shares

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(WHO) and Codex Alimentarius Commission, has recommend risk analysis as the best practice for food safety regulation.

[172] The 2012 *Twelfth Five-year Plan on National Food Safety Regulatory System*, art. 4.

[173] The 2012 *Twelfth Five-year Plan on National Food Safety Regulatory System*, art. 5.

[174] Before GFL, risk assessment is only carried out by MOH when food safety incidents are revealed, but lacks of professional teams of experts and national plans.

[175] Article 13 of FSL gives specific composition of the Committee.

the similar responsibilities as the EFSA built by the Regulation EC 178/2002. [176]

The process starts with a risk profile that contains background information about the food safety problem and its context. Hazard identification is qualitative analysis and provides a procedure to determine if known or potential adverse health effects are associated with particular substances, such as chemicals and microbial pathogens (Serra, Domenech, Escriche and Martorell, 1999). The majority of the hazards are recorded in the sensitive ingredient lists, which includes the materials that have been historically associated with a know hazard (National Advisory Committee on Microbiological Criteria for Foods, 1992). The list usually contains biological, chemical and physical and significant food allergens (Sperber, 2001). And the rest comes from the consumersôcomplaints and expert judgments.

The step of exposure assessment estimates the likelihood that an individual or a population will be exposed to a microbial hazard and the number of the microorganism is likely to be ingested (Lammerding and Fazil, 2000). The assessment should take into consideration of both the characteristics of the substance and the pattern of food consumption, which will need extensive data and related information. To perform the task, NCFSRA needs to consult experts such as food scientists and epidemiologists and collect data from the regional government, where the local branches of public health agencies, usually the county-level, develop plans to monitor food safety and carry out site inspections, samplings, and audits, and report relevant

[176] Two legislations stipulate such requirements. First, the Article 6 of Agricultural Product Quality Safety Law requires that the risk assessment should be carried out in agricultural products. As a result, the Ministry of Agriculture sets up an expert committee on agricultural product quality safety risk assessment. Second, the Article 4 and Article 11 of FSL require the establishment of a national system and assign the responsibilities of assessing foodstuff risks other than agricultural products to MOH. However, Xiao (2011) argues that the artificial division between agricultural and non-agricultural products leaves significant grey areas that could lead to regulatory vacuum.

data to their superiors. Usually statistical models, such as the fuzzy model proposed by Wang, Li and Shi (2015) will be used to process this information and make predictions about the exposure risk.

The step of risk characterization involves all those activities prepared for an effective risk management. The identified risks are ranked according to their previous severity, and the potential social and economics consequence.[177] It should be noted that not all the risks could be reduced to zero, hence the existence of certain minor risks is acceptable. For those unacceptable risks, their causes are spotted and ranked according to the magnitude of their contributions, which determines the future actions to guard consumers against these risks.

4.3.2. Risk Communication

Risk communication is not well performed in China before FSL and transparency of food safety regulation is low (Mol, 2014), although consumers are highly concerned with the food safety information (Liu, Pieniak and Verbek, 2014). There is no systematic communication between government and consumers, except for major food safety crises (Zhang, Mol, He and Lu, 2010). Public agencies possess significant monopoly power over the food safety information and the regional government would like to distort information disclosure once the risk breaks out. They first choose to cover up the situation and conceal the information from their superiors and public, because such incidents impose negative impacts on their career. In addition to such situation, the food information and monitoring system is not well-established due to the low attention paid to communication between government and consumers. When food safety crisis is not so common, consumers facing distorted information are lack of incentives to verify the source of information, and tend to follow the public sources.

[177] Hong Kong employed such classification system in designing their risk management system, which is based on the previous behavior of the business (Wu et al., 2014).

Risk communication is crucial for ensuring that public and stakeholders receive accurate and rapid information so that they could make appropriate decisions.[178] This is particularly important because citizens are easy to get information via internet and hence to be misled by such information. The public lack of the necessary physical, chemical, and biological knowledge to tell the inaccurate information. Wu, Zhong, Shan, Qin (2013) perform an empirical study on the risk perceptions of food additives in Suzhou Province of China, and find that inefficient risk communication among the government, industry and consumers contributes to publicôs suspicion of the food additives that are approved by the government.

Hence, FSL emphasizes that risk communication should be accurate and in time, which improves the level of transparency of food safety regulation in China. The NCFSRA will report the scientific evidence to MOH, which will communicate the received information with other relevant agencies of the State Council, and the public via its website.[179] The risk communication improves the transparency of food safety regulation and undermines the monopoly of information by producers and regulatory. The NCFSRA is also assigned with the task to explain the results of risk assessment and helps the public to understand the relevant technical details. The arrangements are to some extent different from that in E.U., where EFSA is much more independent. It could publish the scientific results directly and the political institutions abstain from the process, whereas in China, the information disclosed by NCFSRA is under the scrutiny of the MOH.

4.3.3. Risk Management

The function of risk management is about weighing policy alternatives in the light of

[178] McEntire and Boateng (2012) argue that instead of causing panic and alarm, effective food safety and food defense risk communication helps to inform consumers.

[179] FSL, art. 15.

results of risk assessment and, if required, selecting and implementing appropriate control options, including regulatory measures. FAO/ World Health Organization (1997) provide a specific procedure guiding the risk management process which includes risk evaluation, assessment of risk management options, implementation of management decision, and monitoring and review. The process is similar in China. It is the MOH that initiates the process of risk assessment to protect human health. Usually the scientific evidence is needed to make national standards, determine the key areas and types for supervision and management, and the risk of new substances (Liu, Xie, Zhang, Cao and Pei, 2013). After the completion of the risk assessment, the MOH will make decisions given this evidence. If the risk assessment finds that the food is unsafe, the relevant public agencies will intervene and terminate the production. If it is proved that the national standards are inappropriate, MOH will start drafting the new safety standards.[180] However, the process is not purely scientific. It should take political elements into consideration.

4.4. The National Food Safety Standards

4.4.1. MOH and New Standard System

As the ISO has defined, the standard is a normative document ñthat provides requirements, specifications, guidelines or characteristics that can be used consistently to ensure that materials, products, processes and services are fit for their purposeò,[181] which is formulated to set unified norms for products in certain agreed formats. The Article 18 of FSL defines the ends of drafting food safety standards to ñensure the physical health of the general publicò. A well drafted food safety standard should be

[180] A case in point is that the risk of new food additives should be assessed before used in production, see Food Additive New Product Administrative Regulations, art. 3 (promulgated by Ministry of Health, 2010).

[181] International Organization for Standardization, ñISO Standardò, available at http://www.iso.org/iso/home/standards.htm.

scientific, which means that it shall not only consider the modern production technology, but the trend of the development in the future. In addition, it should also be reliable because the risk assessment is based on the relevant standards in China, the malfunction of which certainly leads to failure of the system (Ji, 2009). Generally speaking, the food safety standards are built on the national standard system in China, which comprises of four levels: The National standards, the Professional standards, the Local standards and the Enterprises standards.[182]

However, these standards are not dynamically evolved and often obsolete compared to modern scientific and technological advancements. To make things worse, these standards regulating the food safety were issued by different regulatory agencies which lack of consistency in developing, interpreting and enforcing these standards (Wu and Chen, 2013). The feature leads to segmented regulatory system and undermines the effectiveness of regulation. The inconsistent standards tend to result in confusion of market participants and even the regulators. For example, Xiao (2012) pointed out that the regulatory agencies dealing with the edible daylilies crisis in Liaoning Province in 2004 found that standards issued by the MOH and SAC and that by MOH alone were in conflict with each other, which caused difficulty for local agency to properly deal with the products.

The situation is improved, though not perfectly solved, after the enactment of FSL, which requires building a unified system of national food safety standards that differs from the general product standards. It explicitly mandates that national food safety standards at least cover seven aspects, which include 1) the maximum levels of pathogenic microorganisms, pesticide and veterinary drug residues, heavy metals, contaminants, and other substances harmful to human health, 2) the types, scope and dose of food additives, 3) the requirements for nutritional ingredients in main and supplementary food targeted at babies and other specific populations, 4) the

[182] Law of Standardization, art. 6.

requirements for labeling, indications and instructions of food safety and nutrition, 5) the sanitary standard for food producing and trading processes, 6) the quality standards about food safety, 7) the testing methods and procedures.[183]

According to Article 21 of FSL that ñthe national food safety standards shall be formulated and announced by the health administrative department of the State Councilò, MOH is delegated with the exclusive power to set the national food safety standards. To consolidate different standards, the guiding principle is that the levels of contaminants should be kept as low as possible and be safe to the general public and the safe levels of the contaminants are calculated according to the dietary structure and take the total exposure into consideration. In addition, the new system of food safety standards streamlines the structure of regulation into three levels and repeals the Professional standards from the food safety standardization system (Xiao, 2012). Consequently, the government carries out a comprehensive review of national food safety standards and those inappropriate ones are replaced by the new standards.[184] The number of new national food safety standards released from 2010 when the FSL was enacted to 2013 is shown in Table 4.1.

These quality/safety standards could be divided into two types: one type is product-oriented; the other is process-oriented (Zhou, Helen and Liang, 2011). The product-oriented standards mainly concern about the quality/safety characteristics of the foodstuffs and indicate that products meet preset conditions, for example the pesticide residue, artificial additives and bacteria should be under the maximum levels. Whereas the process-oriented standards assure customers that products are produced

[183] FSL, art. 20. The article also includes a fallback provision that requires to develop standards on other measures needed.

[184] The National Food Safety Standard Review Committee was created after FSL and held its first general meeting in January, 2010. The Committee is responsible for examining the existing standards of food safety and making proposals for future revisions and implementations.

and/or handled following specific practices to maintain constant safety and quality levels.

Table 4.1 The National Food Safety Standards

Year / Name	2010	2011	2012	2013	Subtotal
The basic standards of food safety	2	5	3	0	10
The standards of food product	17	3	2	0	22
The standards of the methods for food safety inspection	48	0	0	0	55
The standards of the food production and distribution	2	0	0	1	3
The standards of food additives	95	12	101	0	208
The standards of food related products	0	1	4	0	5
In total	165	21	116	1	303

Source: *The Yearbook of Health and Family Planning in China*, the National Health and Family Planning Commission of the PRC, available at http://www.nhfpc.gov.cn/htmlfiles/zwgkzt/ptjnj/year2013/index2013.html.

4.4.2. Product-oriented Standard

From Table 4.1 we can see that a significant proportion of food safety standards were promulgated between 2010 and 2012, which is ascribed to the fact that the State Council promoted the *Food Safety Rectification Program* in 2009. The program requires that MOH systematically reviews and drafts food safety standards to completely improve the conditions of food safety. In November 2012, the most important national standard ñGeneral Standard for Contaminants in Foodsò (GB2762-2012) is issued by MOH to unify the segmented regulations on contaminants in various foodstuffs. The standards cover 13 contaminants and more than 20 food categories, which serve as the only references for all contaminants in all foodstuffs that are user-friendly to the public agencies, industries and consumers

(Shao, Wang, Chen and Wu, 2014). Using the data from risk assessment, the standards are primarily set for the raw agricultural materials because except certain conditions, the level of contaminants will not increase during the processing.

In addition, several issues attracted most attention from MOH. First, there were around 66 new standards on dairy product enacted in 2010, which is partly due to the repeated product crises. The general products and infant milk and powders are regulated separately. The standards on infant products are much stricter due to the vulnerability of infants. Second, it can be seen from Table 4.1 that the standards of food additives are takes the majority of the new standards, due to abuse of additives to beautify the appearance of products, increase the shelf lives and intensify the tastes. The excessive consumptions of additives are significantly harmful to human health. A new national standard, the *National Food Safety Standard for Use of Food Additives* (GB2760-2011), updated and unified the establishment of food additives.

Third, the labeling standard, *General Rules for the Labeling of Prepackaged Food*, is promulgated to replace the prior one. The rules clearly require that the components and additives should be labeled on the package. The minimum size of the words is also set to be no less than 1.8 mm in height to avoid inefficient transmission of information. Finally, the government agencies also provide certificates to products satisfying some minimum standards, which mainly include hazard free, green and organic food (Liu, Pieniak and Verbeke, 2013).[185] These certificates provide consumers with additional standardized information and reduce the uncertainty of a

[185] The organic food emphasizes that the cultivating process is totally natural, such as the artificially synthesized fertilizers and pesticides are not used, the hazard free food has good quality and its residue content is blow the national standards, and the concept of green food focuses on the high environmental protection and sustainable development. It is obvious that the three certificates differ in their qualities. The criteria for organic food are the highest, that for green food and the last the hazard free food.

productôs attributes. Yet not all the producers have appropriate incentives to adopt these standards, for example, Jin and Zhou (2011) find that perception of standards, reputation, expected costs and benefits and destination markets are positively correlated with the decision of vegetable cooperatives in Zhejiang Province to adopt the quality and safety standards.

4.4.3. Process-oriented Standard

The process-oriented standards assure customers that products are produced and/or handled following specific practices to maintain constant safety and quality levels, which mainly includes ISO 9000, HACCP and QS etc. The system of HACCP is of particular interest, which is voluntarily adopted in China and highly recommended by FAO and WHO (Bai, Ma, Gong and Yang, 2007). It adopts a preventive approach to guard food safety rather than reliance on end-of-product examination that is important for reducing the food safety risks (Jiang, 2011). It is mainly certified by the government-authorized third-party certifications institution, China Quality Certification Center (Bai et al., 2007), and first required to be instituted for all food processors exporting canned food (Xiao et al., 2004).[186] In 2009 after the melamine crisis, a new regulation on the HACCP requirements for dairy enterprises was introduced to standardize the process of milk purchasing, processing, packaging, storing and transporting (Pei et al., 2011).

Wang et al. (2010) report a case study on the conditions of food safety of the vacuum-packed-sauced-pork firms before and after installing the HACCP. Following the seven general principles proposed by the Codex Alimentarius Commission (1997), those firms with HACCP installed obtain a better performance in reducing the level of nitrite and meeting the microbiological standard. Consumers are consequently willing

[186] Both private and public powers try to expand the application of HACCP in the U.S., where government regulation requires HACCP use by meat packers and the downstream buyers often require upstream suppliers to adopt the system.

to pay premium to foodstuff produced by suppliers with HACCP because of its improvement of food safety (Wang, Mao and Gale, 2008). However, the adoption of HACCP is still voluntarily in most of industries of China, and is mainly driven by market power. For example, Jin, Zhou and Ye (2008) find that the firm-size, target markets, understanding of the methods and the education level of the management are the major factors influence the decision to adopt such system. The most significant costs are the costs of training and new equipments, which limit the application of such system in small firms (Maldonado-Siman et al., 2014).

4.5. Summary

This chapter gives a detailed discussion on the Food Safety Law (FSL) and related regulatory reform in China. Before FSL was enacted, the traditional system of food safety regulation suffers from clear drawbacks and is both horizontally and vertically divided. FSL streamlines and clarifies the allocations of the regulatory duties and creates the State Councilôs Food Safety Committee to lead the food safety management and makes national plans for food safety regulation. In addition to changes in the regulatory structure, FSL broadens the meaning of food safety regulation, which covers both the nodes in the supply chain and environment where the food is produced or processed.

In 2011, a new independent agency, the Chinaôs National Center for Food Safety Risk Assessment is created to assume the function of assessing the national risks. However, the risk communication is not well performed in China. There is no systematic communication between government and consumers, except for major food safety crises and public agencies possess significant monopoly power over the food safety information and the regional government would like to distort information disclosure once the risk breaks out. The Ministry of Health takes the responsibility of risk management and weighs policy alternatives in the light of results of risk assessment

and, if required, selecting and implementing appropriate control options, including regulatory measures.

The national food safety standards and self-regulations in the firm-level have changed rapidly since FSL. Ministry of Health (MOH) is delegated with the exclusive power to set the national food safety standards. To consolidate different standards, the guiding principle is that the levels of contaminants should be kept as low as possible and be safe to the general public. The safe levels of the contaminants are calculated according to the dietary structure and take the total exposure into consideration. Around 303 food safety standards are promulgated during the 4 years after the 2009 FSL was enacted, which serve as the guidance for the business operators in food industry.

5. The Traceability System in China

The traceability system is recently developed to combat food safety crisis. It increases the ability of the firm to manage the flow of inputs and outputs, to improve distribution efficiency, to differentiate their products, and to perform ñaccurate and targeted withdrawalsò (Golan et al., 2004). Consumers will feel that producers could control their supply chain and be provided with the information about the product they buy, which will increase their confidence. There are two dimensions of traceability in the food industry: one is the traceability system covering the origin place that the products are produced, *i.e.* the geographical indicators, and the other is the traceability system in the supply chain.

The E.U. GEL mandated that operators at all stages of production, processing and distributions should maintain the traceability system before 1 Jan., 2005.[187] Although Chinese government also shows great interests in promoting food traceability in the supply chain, the system is not compulsory in China. More often, the government policy advocates establishing such system rather than the legislations. Pilot projects of traceability system are first carried out in rich regions sporadically (Mol, 2014).

In 2002, the Beijing municipal government requires that food traders should keep information traceability systems that record the production area, supplier, purchasing date and batch number (He and Chen, 2014). The experience and knowledge accumulated contribute to the application of the system in the 2008 Olympic Games, where an advanced traceability system using RFID and GPS techniques is employed (Lan, Huang and Lin, 2008). It proves to be effective in improving food safety during the event and consumers could obtain detailed information on the food they eat. The success encourages that the Shanghai World Expo also adopted the traceability

[187] Regulation (EC) No 178/2002, art. 65.

system in 2010.[188]

The regulation of the geographical indicators[189] is not developed endogenously in China, but transplanted from E.U. and the U.S. The main drivers of the adaptation of the GI protection are the countryôs willingness to join the WTO. And hence the earliest regulatory framework is directed to follow the requirements of the TRIPS agreement, which mandates that member states should prevent the misleading use of GIs, such as that of unfair competitions.[190] The first regulation is the *2001 Provisions on Protection of Designations of Origin Products*, which is issued by the State Administration for Entryï Exit Inspection and Quarantine and highly influenced by the French system of appellations of origins.[191] Later the American certification and collective marks system is also introduced to protect the products of GI. Now the two systems work together to protect legitimate interests of the local producers, which still needs further improvements to avoid unnecessary conflicts and confusions.

The rest of this chapter talks about the regulatory framework of the traceability system and geographical origins in China respectively: Section 5.1. discusses the general legislations on the food traceability system and Section 5.2. on the practices in different industries, Section 5.3. delivers a discussion on the GI protection system and Section 5.4. a case study of the Longjing Tea. Section 5.5. gives a short summary of

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[188] Available at http://gb.cri.cn/27824/2010/03/02/4865s2770995.htm.

[189] GIs are defined in the Article 16(2) of the *Trademark Law* as signs ó*that identify a particular good as originating in a region, where a given quality, reputation or other characteristic of the goods is essentially attributable to its natural or human factors*ôô. The Article 2 of *Regulation on the Protection of the Product of Geographical Indication* adopts exactly the same definition for GIs.

[190] TRIPS, art. 22(2)(a),(b)

[191] The *2001 Provisions on Protection of Designations of Origin Products* is replaced by the *2005 Provisions on Protection of GI Products* in July 2005 issued by AQSIQ.

the Chapter.

5.1. Legislations on Food Traceability System

5.1.1. Food Safety Law and Traceability System

Although FSL does not mandate that food operators adopt the traceability system, its articles have required some functional characteristics of the traceability system. The food producers need to inspect the certification and license documents of their suppliers when they buy raw materials, additives and related products.[192] They also have to maintain a recording system of their every purchase of these materials, which should be kept at least for two years. In addition, the food producers should also keep a record of the inspections of their outgoing food, feed, or any other substance at least for two years before they deliver them to their buyers.[193] The record should include at least the status of the inspection and certification, name, size, quantity, batch number, production date, inspection number, sales date, name of buyers and their contact.[194] The requirement for inspections is also applied to the producers of the food additives.[195]

The retailers should also check the license and qualification of their suppliers when they buy foodstuffs.[196] They should build a record system of incoming foodstuffs, which include the information about the name, size, quantity, production batch number, date of purchase, expiration date, and supplier name and their contact number. The information should be kept for at least two years. The inventory of foodstuffs should be conserved in appropriate conditions, and regular inspections shall be carried

[192] FSL, art. 36.

[193] FSL, art. 37(1).

[194] FSL, art. 37(2).

[195] FSL, art. 38.

[196] FSL, art. 39.

out to ensure that they are not expired.[197]

The combination of the requirements of suppliers and buyers equals to the concept that the food producers need to keep trace and track ñone step forward and one step backwardò. The difference lies in that the records are most often paper-based and kept by the producer itself, which are quite rudimentary. It is only required when the regulators would like to check if they follow the regulations.

5.1.2. National and Provincial Policies Supporting the Traceability System

It is a great pity that FSL does not explicitly require that food operators are mandated to adopt the traceability system. Luckily, realizing the huge benefits that traceability could bring about to national food safety, the government policies systematically started to promote the system in 2012. The State Council issued the *Decisions on Strengthening the Food Safety Regulation* (The *Decisions*) in that year, which is regarded as the general guiding principles for the building of food safety regulation.

The *Decisions* repeatedly mention that traceability systems should be established to achieve various goals. First, the traceability system should cover all stages of the food supply chain and facilitate the information flow among regulators in different regions.[198] Second, it is an integrate part of the regulatory system of agricultural products.[199] Third, the current technology of the traceability system needs to be upgraded to include electronic and automated instruments, which would improve its effectiveness and convenience.[200]

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[197] FSL, art. 40.

[198] The *Decisions*, art. 5.

[199] The *Decisions*, art. 9.

[200] The *Decisions*, art. 19.

Following the *Decisions*, the General Office of the State Council issued the *Twelfth Five-year Plan on National Food Safety Regulatory System* (the *Twelfth Five-year Plan*) in 2012, which is the action plan for the food safety regulation in the next five years. The *Twelfth Five-year Plan* sets four specific goals to achieve for the traceability system, which includes full coverage of infant formula milk powder and raw material powder, partial coverage of meat, fish and vegetables in cities with population above 1million and western cities with population over half a million, selective coverage of the alcohol products and full coverage of the dietary supplements market.

Instead of pushing the traceability system to all the cities, which is obviously unpractical due to their heterogeneous development levels, a national key program is launched to first build such system in selective cities with the required infrastructures. The program comprises of four pillars in accordance with these four markets. First, a traceability system covers the infant formula milk powder and raw material powder should be built and cover the source, procurement, production, transportation and retails processes. A consistent technology should be chosen by all the operators so that data and information could be shared among producers, government and consumers.

Second, four levels of traceability system consisting of national, provincial, municipal and county-level systems should be established and cover the most-often consumed agricultural products, such as vegetables, meat and freshwater fish. It is crucial for regulators to share information and cooperate with each other. The traceability system should work together with the agricultural product indications to strengthen the regulation of entry into specific regions. Third, the operators should take a dominant role in establishing the traceability system of alcohol, instead of relying on the public sectors. The system mainly aims at reducing the counterfeit products. Fourth, the traceability system for market of dietary supplements shares similar features with that

of the agricultural market, except for that the *Twelfth Five-year Plan* requires a full coverage of all the supply chain.

In February 1st, 2015, the Central Committee of the Communist Party of China and the State Council jointly released the first national policy document, *The Notice on Strengthening the Reform and Speeding up the Modernization of the Agricultural Industry* (*2015 Notice*), which set the national targets to achieve for agricultural industry. In Section 1.3., the *2015 Notice* discuses the measures that should be taken to improve the quality of the agricultural products and food safety, which highlights the role played by the national traceability and information system. A national traceability system of the supply chain, which records and shares the information about food safety and the quality of agricultural products, should be built. It is regarded as an important instrument to combat unsafe food and supply regulators, business operators and consumers with precious information.

Furthermore, a series of national and industrial standards are enacted to provide guidance to market participants. For example, as early as 2005, AQSIQ enacted the *Procedure for Traceability System of Exported Aquatic products* to make these exported products in accordance with the requirements of imported countries. In year 2010 following the enactment of FSL, an additional national standards, *The Guidance for Design and Implementation of Traceability System of Food and Feed* (GBZ 25008-2010), was promulgated to standardize the traceability system of food and feed. Furthermore, based on *The GS1 Traceability Standard: What You Need to Know*, EAN China drafted the industrial standard *Guidance for Traceability System of Beef Products* and *Guidance for Traceability System of Fruit and Vegetable*.

In addition to the national and industrial efforts to push forward the application of traceability system, those wealth cities and provinces also impose stricter regulations and accumulate experiences. These regions have higher fiscal revenues and could assume the investments in the traceability system. Back to 2008 when Beijing was

hosting the Olympic Games, the city started to implement food traceability system of agricultural products using IC card and RFID system recording the information of location, temperature and humidity from their origins to processing enterprises and the Olympic village.[201] After the Olympic Games, the Agricultural Bureau of Beijing City still maintains the traceability system of vegetables and aquatic products. Consumers could check the historical information of these products via websites[202], short messages, telephones and the computer terminals in the supermarket. In 2013, the *Regulation of Food Safety in Beijing City* was promulgated by the standing committee of the peopleôs congress of Beijing City. The Article 53 explicitly requires that the implementation of the traceability system of food safety and edible agricultural products and building an electronic platform to collect, share and publicize information. All the processes including production, acquisition, processing, storage, transportation and final sales should be traceable.

Shanghai City, which held the EXPO in 2010, also has required that the agricultural products supplied to the EXPO garden, which significantly improved the condition of food safety during the event. Based on the experience, the city started to require some of the most commonly consumed agricultural products to be traced since then.[203] In July 2014, the *Measures for Traceability of Food Safety Information in Shanghai City* (*2014 Shanghai Measures*) was enacted, which regulated the foodstuffs and edible agricultural products with high safety risks and consumed volume. *2014 Shanghai Measures* requires that eight kinds of products including grains and their processed products, meat of livestock and their processed products, poultry, vegetables, dairy products, edible oil, aquatic products, wine, together with other products authorized by the municipal business commission, municipal food and drug bureau and the

[201] The news report is available as follows:

http://news.xinhuanet.com/olympics/2007-02/28/content_5784882.htm (in Chinese).

[202] The address of the website is as follows: http://www.atrace.org.

[203] The information is available on the following website: http://www.shian.gov.cn.

entry-exit inspection and quarantine bureau, should be managed by the traceability system.[204] The business operators that are responsible for recording the information are clearly defined, which include enterprises producing and processing the respective products, slaughtering plants, enterprises importing products, wholesale market, business operators in the standardized fair market, medium and large size grocery stores, supermarket, shopping mall, units that are responsible for transportation and distribution, kitchens, school canteens and hotels, which are quite extensive and comprehensive.[205]

The Shanghai Municipality arranges a special funding from its budget to support, manage and operate the system and assigns specific responsibilities to governmental departments. *2014 Shanghai Measures* also stipulates the minimum information to record and report by the business operators: first, the information about the producers; second, the information of the suppliers; third, the product information; fourth, the certificate documents for quality test, and fifth, other relevant information required by laws and regulations.[206] The final retailer should upload the product information they sell to the municipal traceability system and offer consumers the receipt of the traceability information. The offenders of the duties to record and upload relevant information are subject to penalties ranging from 2000 RMB to 20,000 RMB.[207]

5.1.3. Specific Regulations on the Traceability System

Following the *Twelfth Five-year Plan*, MOA issued the *Regulation on the Traceability System of Harm-Free Agricultural Products* (the 2011 *Regulation on the Traceability System*) in 2011 and regulates the traceability of agricultural products

[204] *2014 Shanghai Measures*, art. 3.

[205] *2014 Shanghai Measures*, art. 4(2).

[206] *2014 Shanghai Measures*, art. 13.

[207] *2014 Shanghai Measures*, art. 14.

through a certified logo, which indicates that the enterprise satisfies the requirements of the 2011 *Regulation on the Traceability System*. The required system combines the paper-based and electronic techniques. The producers should manually collect six types of information in according to the Article 17 of the 2011 *Regulation on the Traceability System*.

First, the origins of the product and its environmental information should be collected. Second is the detailed information on the inputs of the products, including pesticide, fertilizer, veterinary medicine, feed and additives, and other inputs. The third one is the information about the environment of processing and storing stages. The fourth is the production date, and the fifth is the information of the down-stream buyers and other information required buy the traceability code. The final one is the person in charge. The information should be uploaded via the central data processor to the database of MOA.

In addition, the MOC, together with the MOF, issued the guidance on building the pilot projects of the traceability system of the meat and vegetable in 2010.[208] The pilot projects selected 10 cities and provided funding to build the system in the large wet markets, supermarkets, slaughter houses, and public procurement entities. It especially emphasized the ability to trace back the supply chain and identify the person that is responsible for the food safety crisis. Similarly, a uniform technical standard should be adopted and centralized database should be built, which will enhance the information sharing between stakeholders. The high techniques are encouraged to be applied, such as RFID and Barcode.

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[208] See The *Notice on the Pilot Projects Constructing the Traceability System of Meat and Vegetable*, available at http://www.pkulaw.cn/fulltext_form.aspx?Db=chl&Gid=139023&keyword=%E8%BF%BD%E6%BA%AF&EncodingName=&Search_Mode=accurate (In Chinese).

Based on the previous experience, the MOC issued two standards that provide the detailed content that each of the operators along the supply chain should record in 2011.[209] For the meat industry, the MOC requires the establishment of the traceability system covering all the phases of the process including the entry, slaughter, quarantine inspection and examination, and leaving the plant. The slaughter house should collect information of its basic conditions, the buyersô information, the suppliersô information, the quarantine inspection and examination results, and the information of the transactions. To achieve these goals, the operators should employ staff members that are well trained and have basic knowledge of the system.

For the vegetable industry, the traceability system is oriented the wholesaling and retailing phase. In the wholesale market, the operators are responsible to record their supplies of the vegetables and the pesticide residues. They have to record the information of the information of their suppliers, the information of the wholesalers, the information of the vegetable products, the information of the testing and examination, and the information of the transactions.

AQSIQ issued the *Measures for Supervising the Inspection and Quarantine of the Import and Export Aquatic Products* in 2011 (the *2011 Measures*), which regulates the market for import and export of aquatic products. The *2011 Measures* requires that the traceability system should cover all stages from fishing vessels to the exported vessels, and the inspection and quarantine institutions should perform the regular inspections at least once half year. Zhang et al. (2011) argue that the traditional paper-based traceability system has significant shortcomings when applied to aquatic markets. It is highly expensive, unable to use the accumulated information

[209] See the *Basic Requirements for the Traceability System of the Circulating Vegetables* and the *Basic Requirements for the Traceability System of the Circulating Meat*, available at http://www.pkulaw.cn/fulltext_form.aspx?Db=chl&Gid=147228&keyword=%E8%BF%BD%E6%BA%AF&EncodingName=&Search_Mode=accurate (In Chinese).

and cannot satisfy multiple tasks, which does not take the specialty of the market into consideration.

5.2. The Application of the Traceability System in China

5.2.1. The Public Sector

Although the central government is pushing the traceability system, which is regarded to contribute to food safety (Ortega, Wang and Widmar, 2014), the system is not extensively adopted in most regions of China. The local governments are lack of inputs and incentives to promote the system. Yang et al. (2012) employ a comprehensive survey carried out by the MOA on the establishment of agro-food traceability system, which includes 17 provinces, 4 autonomous regions and 2 municipalities in 2010. They report that most of the municipalities (83.5%) have already established the centralized institutions in charge of coordination of all the agro-food quality and safety supervision departments. This is an significant improvement after the passage of FSL.

However, for the low levels government, such as townships and villages, the resources invested to carry out safety-control tasks are limited. Only slightly more than half of the surveyed cities have separated funding for agro-food control (57.2%). For those municipalities that have such budget, around 70% have an annual budget less than 1 million yuan, and only 10.9% of these agencies report that the budget is enough to meet their demands. Due to the limited budget, only 14.6% of the townships had set up the Agro-food Safety Public Services, which are responsible for promotion of recent advancements in technologies, training of local farmers, and enforcement of the safety regulations.

It is not surprised that the local governments are disincentivized to promote the system. Around 50% of the municipalities surveyed report that they have established

the traceability system. The application is not even across China. Those rich regions, such as the eastern coastal ones and central ones, have established the agro-food control systems, the traceability system in specific, much better than those northern and western regions do. The average ratio of traceability application in eastern and central China is around 60%, while the ratio in northern and western China is around 35%.

In contrast, the special region Hong Kong has built a good traceability system and a reputation for keeping high level of food safety. The Food Safety Ordinance was enacted in August, 2011, which provides government with a systematic tracing and tracking system of foodstuffs (Wu et al., 2014). All the operators should be registered with the Food and Environmental Hygiene Department. The system ensures that government could react quickly to food incidents. The regulation of imported foodstuffs is important because of its limited land area. Hence, a registration scheme for food importers and food distributors is established, which requires that these operators should keep records on the acquisition and supply of foodstuffs.

5.2.2. The Enterprises

The application of the traceability system is far from satisfying. Yang et al. (2012) report that the system is introduced haphazardly and mainly in those large firms, and the SMEs and firms in western regions are not covered. Unified standards are not developed and the system mainly focuses on the quality and risks of the end product rather than the entire value chain. Due to the large amount of fixed investment in the equipment, the percentage of the small business that adopts the traceability system is relatively low. Xu, Shan and Wu (2011) survey 263 farmers growing apples in the Jiangsu Province and report that only 22% of these house famers participated in the traceability system of agricultural products. Zhou, Wang and Zhang (2011) find that ignorance of the small business about the system significantly accounts for their reluctance to adopt the traceability system. But their lack of incentives to build the

system is reduced if the government could provide subsidiaries. Wang and Qiao (2011) report that with subsidiaries, 72.7% of peasants in Beijing growing vegetables would like to join the traceability system.

In comparison with the small business, such as farm houses, large and medium enterprises along the supply chain have much better management systems, which include food quality and safety as an integrate part. As a result, they are more prone to adopt the traceability system to improve their management efficiency. But as rational players in the market economy, they will weigh the benefits and costs of such system. The majority of the operators still regard that the traceability system will bring about significant value. Shan, Wu and Xu (2011) conduct a survey on the food producing firms in Henan Province, which is the largest province producing the agricultural products. 76.4% of these firms think the traceability system would bring positive benefits via improving the quality of their products. In addition, 63.6% of them think that the system will increase their sales.

However, it is worth noticed that for those firms with low value-added products, the traceability system is information-oriented and established mainly to conform to governmental criteria. For example, the vegetable industry in Shandong Province has built a traceability system mainly under the force of the public policy. It is used to collect information of the producing, processing, distribution and consuming stages and facilitate the product-recall (Article Numbering Center of China, 2011). The system provides a platform for producers, regulators and consumers to communicate.
report

Chang and Chang (2011) report that the traceability system of agricultural products is poorly implemented in Taiwan. The Taiwan Agriculture and Food Traceability (TAFT) program was launched in 2004. After five years, the program has a very low participating rate. They find that lack of advertising the program is the major determinants because a high percentage of operators are not aware of such program.

In addition, it is important to provide training programs and workshops that increase the related human capital of the operators. Finally, the benefits of the traceability program in reducing the pesticides residues should be communicated with the operators.

5.2.3. The Consumers

The *Twelfth Five-year Plan* names four markets that should be covered by the traceability system, which include markets for dairy products, meat and vegetable, alcohol and dietary supplements. Research has been carried out to investigate the attitude of the consumers in these markets towards the traceability system and their willingness to pay for the system. Generally speaking, consumers are highly unsatisfied with the food safety conditions and call for measures to improve it.[210] Song, Liu, Wang, and Nanseki (2008) report that over 90% of their respondents indicate the traceability system is very necessary.

But the premium they would like to pay for such system is limited. Unlike consumers in most of European countries, Chinese consumers are very sensitive to food price.[211] Wang, Zhang, Mu, Fu, Zhang (2009) survey the consumers of fish products in Beijing and show that a very low percentage, around 19.6%, of consumers are aware of the traceability system implemented in early 2006. Around 21% of the respondents are not willing to pay a premium for that program, and the average price premium paid

[210] For example, the fear of food safety incidents is strongest after the melamine scandal in 2008, and Wu and Xu (2009) report that 86% of consumers believed that food production in their cities suffered from safety issues. The situation improves when the negative effects of the crisis are diluted. Xu and Wu (2010) surveyed consumers in Jiangsu Province and found that 36% of their respondents are strongly dissatisfied with food safety conditions.

[211] It is possibly quite common among the developing countries, for example, Unusan (2005) report that the price is the first determinant of the consumersôchoice of foodstuffs in Turkey.

for all the respondents is only 6%.[212] Zhang, Bai and Wahl (2012) survey the consumers in the Jiangsu Province on their attitudes towards pork, milk and cooking oil, which are all basic consumed foodstuffs.[213] Again a high percentage of these surveyed consumers are not aware of the food control system and they have no idea about the contents of different logos on the product. They are willing to pay additional premium around 21.7 percent, 19.8 percent and 16.7 percent for traceable milk, cooking oil and pork respectively. The willingness-to-pay increases when they are provided with additional information about the system.

5.2.4. Potential Improvements

It is not surprised that the traceability systems encountered many difficulties in China. Some of these are technical difficulties and some are political. This subsection discusses the potential barriers from perspective of the supply side and demand side of the food market and their possible solutions to facilitate the application of the traceability system. The obstacles faced by the supply side of the market, *i.e.* the operators of the food markets, are as follows. The first and foremost problem encountered is the significant costs of building and learning to use the system. For the vast majority of the small-scale and scattered operators in China, the production recordkeeping and transferring of the information are too expensive, which will significantly raise the price of their products. In the food market, the low value-added products are in fierce competition, the increased price will significantly reduce the sales. In addition, the owners and staffs of these producers are not well-educated and learning to use the high-tech system is a huge challenge for them, which undermines the attractiveness of the system to improve food safety.

Due to the fact that the market for food safety has market failure, *i.e.* the asymmetric

[212] The premium is similar to that for HACCP reported by Wang, Mao and Gale (2008).

[213] Recent years, the illicit cooking oil has emerged as a serious threat to safe food in China, see Lu and Wu (2014) for an analysis.

information about the food safety, the government should play an active role in supporting building the system. However, Zhang, Feng, Xu and Hu (2011) report that only 10% of the firms they surveyed are satisfied with the support from the government concerning equipment and software purchase. Relying on the market power alone, for example, if some of the high quality firms first adopt the system, the price of their products will rise significantly. Their products will be less competitive, and these firms will tend to lose money. Hence, the low-quality firms will take the market.

The second obstacle encountered is the need to improve the accuracy of the reading and writing process. Zhang, Lv, Xu and Mu (2010) report a case study of a firm in Shandong Province and their expectations about the traceability system. The accuracy of the reading process is important, because errors cost a lot of time and efforts to correct. The old-fashion techniques, such as barcode and paper-based system, is proved to poorly functioned in the high-temperature and humid ambient environment.[214] A possible solution to increasing the reading accuracy would need to introduce the high-tech equipments such as Personal Digital Assistant and RFID into the supply chain (Xiong et al., 2010; Yang et al., 2012).[215]

Another recent development of the traceability instrument is the wireless sensor network, employs the wireless transmission and has the advantage of overcoming the adverse working conditions (Lin et al., 2011). It combines the sensor technology, embedded computing, networking and wireless communication technology and distributed processing and plays an important role in the traceability of the

[214] The old-fashioned techniques also impose significant barriers to the communications between different segments of the supply chain, for example, from farm to slaughter and from slaughter to cutting floor (Sun et al., 2007).

[215] See Feng et al. (2013) for a scientific design of the RFID-based traceability system for cattle/beef industry.

aquaculture industry. Due to the fact that the General Administration of Quality Supervision, Inspection and Quarantine requires compulsory traceability systems to all aquatic products export companies, the technology solves the problem that the bar code and the traditional wire transmission could not function in the water.

Finally, the operators not only expect that the traceability system will perform the function of record keeping, they also hope that the system could fit into their supply chain management. It should be able to constantly monitor the whole production processes and to assure food safety via its connection with the intra-firm level intranet. Combined with other techniques, for example, the HACCP, the system could send warning signal if the critical point report irregular data. The system should be able to determine exactly at what stage and time the error had occurred when anything goes wrong in the production process. Finally, the system should be able to facilitate the call of the products.

For the demand side, *i.e.* consumers, the major obstacles to application of the traceability system are their lack of awareness of the system. Their attitudes and perceptions of the traceability system significantly decide their willingness-to-pay for the traceable foods (Wu et al., 2012). Xu and Wu (2010) report that only 37% of the consumers they survey have heard of food traceability system. Since the Chinese are very concerned about their health, educational efforts promoting the traceability system might help establish a market for premium safe foods, which is filled with high quality food with higher price (Liu, Pieniak and Verbeke, 2013).

5.3. Regulations of Geographical Indicators

The recent survey shows that there are around 2300 GIs applied until 2010, of which around 40.69% are GIs of vegetables and fruits.[216] These GIs are dispersedly

[216] The survey is carried out by the Beijing Zhongjunshiji GIs Research Team, which is available at http://district.ce.cn/zg/201101/15/t20110115_22143582.shtml (last accessed 18/02/2015).

distributed in the different provinces in China, with Shandong, Sichuan and Zhejiang ranking the highest. The regulatory system of GI protection in China combines both the European *sui generis* protection and American certification and collective trademarks (Wang and Irina, 2007).[217] The GI system emphasizing the link between the quality of the product and the production area is supposed to promote the environmental protection, the quality of agricultural materials and sustainable production, and the food diversity, which can help to preserve traditions, increase the income of local stakeholders and prevent delocalization.

The two systems are administered by different governmental agencies. The collective and certification marks are regarded as a means of active protection, whereas the *sui generis* protection is devised to provide public agencies to manage the appellations of origin (Wang, 2006). The AQSIQ first built the *sui generis* protection system in 2001 and Ministry of the Agriculture took the responsibility for the regulation of agricultural GIs in 2007. SAIC regulates the American certification and collective trademarks system. Around 23.76% of registered GIs are regulated by MOA, 20.42% by SAIC and 36.69 by AQSIQ. Some of the products register in two al three systems. The protection of the legitimate interests of the GI holders is regarded as an important part of protection of the property rights in China (Wang, 2009).

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[217] The third approach, which is identified by Bashaw (2008), is the unfair competition law. Business operators holding the GI could protect their legitimate interests using the Article 5(4) of the *Law Against Unfair Competition* (effective Dec. 1993), which prohibits forging the origins of the product and their quality. Wang and Huang (2006) comment on the reason that there are dual systems to protect GIs lies in that the collective and certification mark system fails to provide enough protection to products of GIs. The Trademark Office of China lacks resources to provide special protections to products of GIs and the holders of the collective or certification marks are the *ad hoc* associations for applications, which have no enough personnel, budget and incentives to promote and protection products of GIs.

Similar to the food safety regulation system discussed in the previous section, the GI regulation system is also divided among several agencies. The segmented legislation is preserved to promote the interests of the regulatory agencies. However, the dual regulatory system compromises the effectiveness of GI protection and increase the compliance burden of the business operators. The regulatory overlaps make the business operators unclear about which rules to follow and it is possible for these agencies to shift responsibilities when food safety crisis breaks out. The rest of this section discusses the features of the two regulatory approaches in China.

5.3.1. Public Approach: *Sui Generis* Protection

The *sui generis* protection of GIs is featured with intense governmental intervention, where the public authorities promulgate legislations pertinent to protecting specific GIs. The protection includes an official recognition and common logo and the AQSIQ is responsible the system basing on the *2005 Provisions on Protection of Products with Geographical Indicators* for non-agricultural products and the MOA is responsible for agricultural GIs basing on *2008 Measures for the Administration of Geographical Indications of Agricultural Products* (*2008 Measures for Agricultural Products*). By 2009, AQSIQ has registered 932 products, which also includes handicrafts and traditional Chinese medicines, in addition to the agri-food products (Wang and Toulouse, 2010).

The application process for AQSIQ granted GIs depends on the actions of the local government. Depending on the area of GIs, the applicants should be appointed by the county, municipal and provincial government respectively.[218] The applying documents should contain information on the geographical area, the creation of the applying organization, the application form for GIs including the explanations for the geographical features, the link between these features and the natural factors and humanity, standards for production and the history of the product, and the technical

[218] *2005 Provisions on Protection of Products with Geographical Indicators*, art. 8,9.

standards for the product.[219]

AQSIQ first conducts a formal examination on the applying documents, and makes announcement about the application. Interested parties need to raise objections within 2 months. Without any objections, AQSIQ will assemble an expert committee to examine the technical details. If all these procedures are satisfied, the GI will be granted. However, due to its public nature, any producers that would like to use the GI should make applications to the local Quality and Technical Supervision Bureaus and Entry-Exit Inspection and Quarantine Bureau. These public agencies are responsible for examining and ensuring the quality of the GI products.

The 2*008 Measures for Agricultural Products* only provides GI protections to the primary products of the agricultural industries.[220] The system shares similar features with that established by AQSIQ and relies on governmental interventions. The application process charges no fees, but the administrative departments of agricultural industry at county level or above should assume the costs and select appropriate cooperatives and associations as applicants.[221] The applicants need to file materials including registration forms, the certificate for applicantôs qualification, the productsô unique features, the technical standards for environmental conditions, production and safety standards, the geographical area covered by the GI and product samples, to the administrative departments of agricultural industry at the provincial level for prescreening.[222]

The MOA will assemble expert committee to review the application and make final decisions if the GI should be awarded. The decision will be made publicity and

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[219] *2005 Provisions on Protection of Products with Geographical Indicators*, art. 10.

[220] *2008 Measures for Agricultural Products*, art. 2.

[221] *2008 Measures for Agricultural Products*, art. 5, 6, 8.

[222] *2008 Measures for Agricultural Products*, art. 9, 10.

interested parties could file oppositions within 20 days.[223] The GI is granted for perpetuity without any need to renew it, which differs from the trademark that should be renewed every 10 years (Zhao and Li, 2012). Once the GIs are granted, the holding associations or cooperatives could make licensing contracts with qualified producers, which should not charge any fee.[224] The administrative departments of agricultural industry at county level or above are responsible for monitoring and managing the GIs located within their jurisdictions.

5.3.2. Private Approach: Certification and Collective Marks

The certification and collective marks protections of the GIs involve little intervention of public authorities and mainly rely on the private negotiations. Stakeholders take private actions basing private law, such as trademark laws and laws against unfair competition, to protect their own interests. The SAIC regulates the system basing on the *Trademark Law*, *Regulation on Implementation of Trademark Law* and *Measures Regarding the Registration and Administration of Collective and Certification Marks (Measures for Collective and Certification Marks)*. By the end of March 2009, 496 products have been registered with the SAIC, of which 465 are originated from China and 31 from seven foreign countries (Wang and Toulouse, 2010).

The *Trademark Law* only provides general protection for GIs from misleading the consumers.[225] The *Regulation on Implementation of Trademark Law* makes it possible for applicants to register GIs as the collective marks and certification marks.[226] The application process is mainly governed by the *Measures for Collective and Certification Marks*. Usually the qualified applicants are the communities, associations and other organizations consisting of members from the area covered by

[223] *2008 Measures for Agricultural Products*, art. 12.

[224] *2008 Measures for Agricultural Products*, art. 15.

[225] *Trademark Law*, art. 16.

[226] *Regulation on Implementation of Trademark Law*, art. 4.

the GIs, instead of individual firms.[227] Before applying for the collective and certification marks, the applicants should get the permission from the local government.[228] Similarly, foreign applicants that would like to register GIs as collective and certification marks, have to obtain legitimate protection from their own countries.[229]

To register GIs as collective and certification marks, the applicants should file materials to the Trademark Office of China, which assumes no roles in searching for conflicting rights. If no interested parties raise oppositions within three month, the Trademark Office will grant the registration. In addition to the regular information required for the trademarks, those about the GIs should also be filed. The application form should contain: first, the information about the qualities, reputations and other related characteristics specific the product. In addition, how these characteristics are related to the natural factor and the humanity. Finally, the geographical area encompassed by the GI. The applicants should also prove their abilities to monitor the quality of the GI-related products by showing their technical staffs and equipments.[230]

Furthermore, the governance rules regarding the applied GIs should also be filed with the application form. Due to its public goods natural to its members, the documents governing the technical standards about the GIs and the procedures for members to use these GIs should also be set by the applicants.[231] Any party satisfying these requirements is entitled to the use of GI marks.[232] The applicants should assume the

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[227] *Measures for Collective and Certification Marks*, art. 4(2).

[228] *Measures for Collective and Certification Marks*, art. 6(1), the article provides a pre-screening procedure for the qualification of the identities, and restricts the entry of the GI market.

[229] *Measures for Collective and Certification Marks*, art. 6(2).

[230] *Measures for Collective and Certification Marks*, art. 5.

[231] *Measures for Collective and Certification Marks*, art. 10, 11.

[232] *Measures for Collective and Certification Marks*, art. 18.

responsibilities to guarantee that all the members follow the technical standards and perform regular testing. Finally, if the quality of the GI products falls below the stipulated level and causes harms to consumers, the public agencies of administration and commerce could impose sanctions up to three times of the illegal gains (maximum 300,000 RMB).

5.3.3. Conflicts and Inefficiencies of the Dual Protection System

Without any doubt, the GI protection systems have been contributing to the healthy development of the food industry in China and are growingly recognized by domestic consumers. However, there are still several aspects that could be improved. First, it should be noticed that the GI protection systems are segmented and there are some overlaps, which are sure to cause confusions (Zhao, Finlay and Kneafsey, 2014). There is no clear rule regarding the priority between the certification and collective marks and the *sui generis* GI protections (Bashaw, 2008). Although the existing case about the *Jinghua Ham* seems to support the idea that the AQSIQ does not consider the registration of collective and certification marks when it registers GIs, the judgment has its own limitation and may not be able to apply widely. Furthermore, the certification and collective marks could not exclude entities that satisfy the stipulated requirements from using the marks, while the *sui generis* GI protections forbid any use or forge of the GI signs. The coexistence of the two systems could result in conflicts of whether the producers could use the GI symbol.

Second, the development of the production standards is driven by heterogeneous interests of the members, which could lead to inefficient standards. For *sui generis* protection system, the government is highly involved, who hold little interests in the product. Due to the heterogeneous interests of the members, it is likely that the quality standards and governance structures are biased towards particular parties rather than maximizing the interests of all the producers.

The final major weakness of the current GI protection systems is that rules are not strictly enforced and the costs of unlawful acts are relative small compared to potential illegal benefits. This is particularly salient in the wine industry, where the product quality is highly associated with the geographical origin (Calaguas, 2005). The victims of the counterfeiting wine usually file civil cases seeking compensation via court system (Kehoe, 2013). In addition, the secondary processing of qualified raw materials, such as partitioning, grinding and packaging processes, outside the protected area constitute a grey zone of the GI protection (Feng, 2008). It is hard to strictly enforce such activities that may undermine the quality of GI products. Finally, the magnitude of the penalties is limited. Yang (2008) has pointed out that there is lack of criminal sanctions to these crimes that would significantly deter potential infringements.

5.4. Case Study: Longjing Tea

This subsection performs a case study on a product of GI, the Longjing Tea in Zhejing Province. Longjing Tea is kind of green tea and has been widely consumed as a daily beverage for a long time starting from *Tang Dynasty* (618 AD), which has a special quality linked to the breed of the tea tree, its growing environment, the cultivation and processing techniques.[233] The tea is famous for its good taste and scent and is popular among tea consumers. Longjing Tea has obtained the both *sui generis* protection and certification mark to enhance the protection of producersôlegitimate interests.[234]

[233] See Hangzhou Daily Press, available at http://hzdaily.hangzhou.com.cn/hzrb/html/2011-08/12/content_1117426.htm.

[234] The product is also actively apply for GI protection abroad, for example, Evans (2010) reports that Longjing Tea has obtain the protection as GI in Europe on 11 May, 2011. See also the EU-China Geographical Indications "10 plus 10" project, available at http://europa.eu/rapid/press-release_IP-12-1297_en.htm.

5.4.1. The *sui generis* protection of Longjing Tea

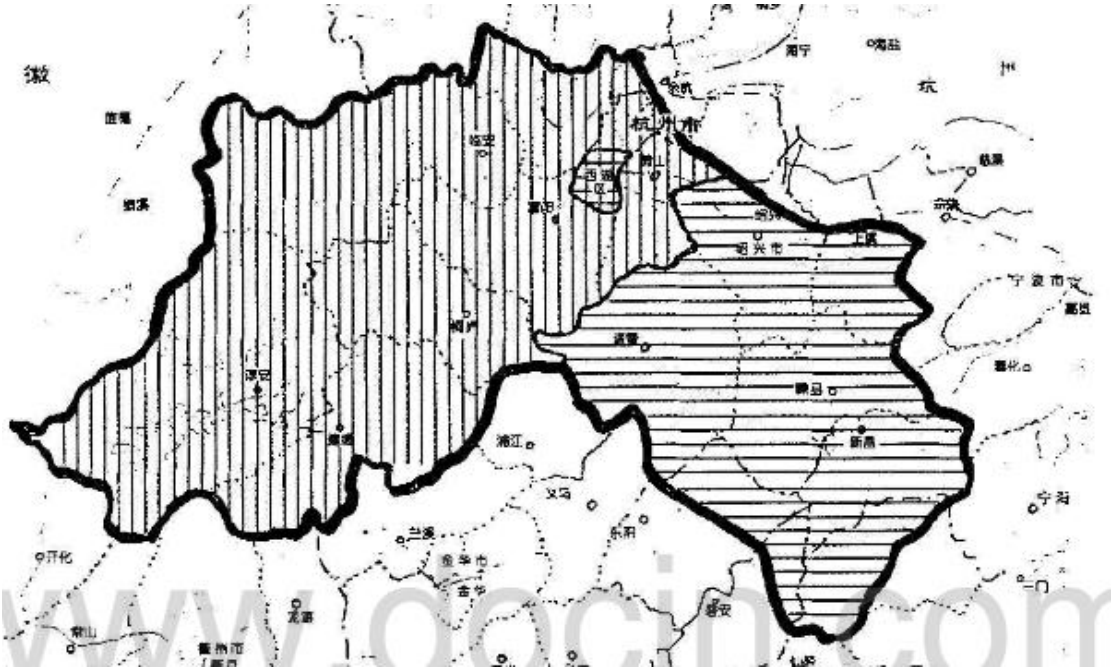
AQSIQ granted the Longjing Tea the national standard *GB 18650-2002* in 2002, which was renewed by *GB/T 18650-2008* in 2008 in according to the *General Requirements for Standards on Products of Geographical Indications*. The geographical area consists of Xihu producing area, Qiantang producing area and Yuezhou producing area, which is shown in Figure 5.1 and contains detailed technical standards for the product. The national standard has specified the geographical environment for producing the Longjing Tea. The covered area of GI is the mountain and hill areas around the Qiantang River and Caoe River, which is warm and rainy.[235] The soil is sub-acid with PH 4.3-6.5.

The cultivation is very delicate and should follow the procedure. The sapling of the tea should be the certified fine breed and have high quality. In the end of the February, farmers should apply the first fertilizers, and the topdressing should be done before the summer tea is grown up, which is usually 4 to 5 months after picking the spring tea. The topdressing for autumn tea should be applied during the June to September every year and farmers apply the base fertilizer in October.[236] The application of pesticides should be strictly regulated and follow GB 4285 and GB/T 8321.

Figure 5.1 The Protected Area of the Longjing Tea Product of Geographical Indication

[235] Zhou, Zhu, Ren, Zhang and Gu (1995) test the geochemical features of the soil in the area covered by GI and find that the soil are abundant with K and P, Mg, Zn, B, Fe and MO, which are beneficial to the taste of tea, but few with Hg and Pb, which are detrimental to the taste of tea.

[236] The basic fertilizer consists of organic, phosphorus and potassium fertilizer, the topdressing is mainly comprised of inorganic nitrogenous fertilizer.



Source: *GB/T 18650-2008*

When there are 10 to 15 qualified tea shoots per tree, farmers could start plucking. For spring tea, every tree should be plunked once every two days, and for summer and autumn tea, the time gap could be prolonged. The collected tea shoots should be stored in the basket rather than plastic bags to avoid squeezing. The processing procedure is performed with the traditional stoves or electronic ones to roast the tea leaves, which could be roasted and dried by hand or by equipment.[237] Most of the Longjing Tea is processed in the scattered households rather than large enterprises, for example, in the Xinchang county of Shaoxing city, around 80% of the tea is processed by households (Lu and Mao, 2011). The dominance of the small producers makes it difficult to upgrade the industry, to achieve economy of scale and to invest in market promotions.

The Longjing Tea is classified into 6 grades based on the shape, scent, taste and color

[237] The traditional way to roast the tea is perform by hand, and there is a specific set of hand skills. In *GB 18650-2002*, the tea roasted by equipment is not treated as the product of GI, which is abolished in *GB/T 18650-2008.*

of the tea and the back of the tea leaves.[238] For example, for the superfine grade, the shape of the leaves should be flat and clear, straight, green and fresh; the scent should be long-lasting[239]; the tea should be clear green. In addition, the moisture content should be below 6.5% for first three class and 7% for the rest three. The powder and fannings should be below 1% for all the Longjing Tea. The residue of pollution and pesticides should follow the national standards BG 2762 and GB 2763 respectively.[240] However, the classification is mainly dependent on human judgment, which is not stable.

Those producers qualified the requirements of *GB/T 18650-2008* could use the symbol of GI, if they obtain the required permissions. They have to label in the package their producing area. The package should follow the requirements of BG7718. The national standard *GB/T 18650-2008* proposes a procedure to test the quality of the products basing on the appearance; the chemical and physical features including moisture content, the percentage of powder and fanning, ash content and aqueous extract; the product safety indicators and net weight. The failure of any of the above standards will lead to the batch of products unqualified.

5.4.2. The Certification Mark Protection of Longjing Tea

On 7 December, 2008, the Longjing Tea was granted the certification mark, which represents a new phase for the development of the product. However, due to the regulatory arrangement of the Trademark Law, the collective mark of Longjing Tea

[238] *GB/T 18650-2008*, Table 2.

[239] Dai and Xu (2008) use the method of solid Phase micro-extraction to analyze the components of the scent of Longjing Tea and find in total 32 chemicals that form the special scent of the tea.

[240] Various technologies are invented to improve the precision of determining the quality grade, which was mainly determined by human panel. Yu and Wang (2007) apply the electronic nose to separate different grades of Longjing Tea and find that the discrimination percentage is higher than 80 percentage.

could be confused with several other trademarks. According to the Article 16 of the *Trademark Law* in China, if the trademarks are registered *bona fide* prior to the certifications marks, they are allowed to coexist with each other. The ñXihuò tea, which is a very famous producing area of Longjing Tea, has been registered long before the certification mark of Longjing Tea. In addition, 28 June, 2011, the ñXihu Longjing Teaò is registered as the certification mark.[241] These similar names for green tea makes consumers confused and could fail to identify the product needed.

To use the certification mark, producers should, on one hand, satisfy following subject qualitfication (Lu, 2010). First, the applicants should be qualified market participants with business license and required machines. Second, the plantation areas should be in the 18 protected counties of these 4 cities: Hangzhou, Shaoxing, Jinhua and Taizhou, which cover around 7333.3 square kilometers and 380,530 households. Finally, the processing procedure and quality standards should follow the national standard GB/T 18650.

On the other, the applicants need to file materials through the administrative procedure. The main administrative department of tea above the county level is in charge of reviewing the application. After receiving the application document, these administrative departments will inspect the plantation, processing and product quality of the producers. If the requirements are fulfilled, the administrative departments will notice the holders of the certification mark, the tea production associative, which again will review the qualification of the applicants. At last, if all these conditions are satisfied, the permit card of Longjing Tea will be issued.

5.4.3. The Traceability System of the Origin of Longjing Tea

The most urgent issue with the traceability of the Longjing Tea is to test the authenticity of the product, which verifies and tests the origin of the claimed Longjing

[241] ñXihu Longjing Teaò is a type of ñLongjing Teaò.

Tea. Although, the government and producers recognize the necessity to build the traceability system, there has not been an established one for Longjing Tea.[242] Academics have been proposing plans for such system. Zan, Lu and Shang (2012) draft a traceability system using two-dimension code, which contains information about the enterprises, the management, the processing procedure, the geographical environment for plantation, the cultivation method and the testing procedure, which covers all the steps ñfrom gardens to cupsò.

In addition, chemical and physical techniques are invented to distinguish fake Longjing Tea. To trace the authentic Longjing Tea, the Tea Research Institute of the Chinese Academy of Agricultural Sciences has developed a method using High-performance liquid chromatography (HPLC) and near-infrared technology to build the fingerprint spectrum of Longjing Tea.[243] Using this spectrum, both He et al. (2012) using near-infrared spectroscopy and Wang, Wei, Cheng, He, Li, Gong (2014) employing HPLC achieve a very high successful rate to test the authenticity of the claimed Longjing Tea.

5.5. Summary

China has started building its traceability system for less than two decades mostly for satisfying the requirements of the WTO. This is a relatively short time compared to the well-established system in both U.S. and U.K. The traceability system is not mandated by FSL and mainly adopted by business operators for commercial reasons. Most of the established traceability system along the supply chain is still in rudimentary status and need further development. There are three public authorities

[242] It should be noted that Longjing Tea is slow in building the traceability system. For example, Anji white tea, which is also cultivated and produced in Zhejiang province, has achieved traceability using the two-dimension code, available at http://www.xinnong.com/news/20140321/1164596.html.

[243] See http://www.tricaas.com/TriKy/Kydt/20110722/1550.html.

involved in regulating the traceability system. MOA regulates the traceability of agricultural products; MOC, together with the MOF, regulates the meat and vegetable industry; and AQSIQ regulates the market for import and export of aquatic products. The segmented regulatory system generates significant inconsistency in the regulation and compliance costs to enterprises.

Dual systems of GI protection coexist in China, where SAIC is in charge of collective and certification marks and AQSIQ and MOA is in charge of *sui generis* protection. The government is highly involved in the *sui generis* protection system, where the local government will appoint the applicants, who later file applying documents including information on the geographical area, the creation of the applying organization, the application form for GIs including the explanations for the geographical features, the link between these features and the natural factors and humanity, standards for production and the history of the product, and the technical standards for the product, to AQSIQ for review.

In contrast, the certification and collective marks protections of the GIs involve little intervention of public authorities and mainly rely on the private negotiations. The applicants file the materials to the Trademark Office of China, which assumes no roles in searching for conflicting rights. If no interested parties raise oppositions within three month, the Trademark Office will grant the registration. In addition, the technical standards and governance rules are drafted by applicants and monitoring activities are assumed by the holders of the certification and collective marks.

The case study of Longjing Tea provides a vivid picture about how the traceability system functions in China. The *sui generis* GI protection materials are detailed about the geographical area, the technical standards for plantation, cultivation, plunking, storing and processing activities. However, there is no established traceability system for the Longjing Tea. Some efforts are made in the laboratory, such as the HPLC and near-infrared technology are employed to test the authenticity of the claimed Longjing

Tea, which makes it possible to trace back to the origin.

6. Conclusion

This dissertation is devoted to analyzing the role of traceability system in improving food safety with a comparison between E.U. and China. Europe has a renowned reputation for safe and high quality food, but China has been trapped into a series of scandals of poisonous food and consumers have lost confidence in domestic food productions recently. In a series of national plans, the Chinese government repeatedly declares its determination to improve the food safety level and restore consumersô confidence. The problem of asymmetric information in the food market is the major obstacle for safe market. Generally speaking, the food is credence or experience product, the quality of which is usually uncertain until it is consumed. Sellers along the supply chain enjoy information advantages about their own products and buyers sometimes have little knowledge about their suppliers due to prolonged supply chain.

We see traceability system as a cure for the problem of asymmetric information in the food market, which could accumulate the information of the geographical origins and along the supply chain. According to the Regulation (EC) No 178/2002, traceability system is defined as ñthe 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 distributionò. The information is important for consumers to appropriate choices, without which consumers need to spend high costs in searching and verifying to avoid consuming unwanted foodstuffs.

More importantly, the information is important for public regulators. On one hand, given a food crisis has already been revealed, the traceability system facilitates targeted withdrawal and recall of food. On the other hand, the information makes it possible to assign the costs of unsafe food to the sources, for example, the traceability system provides evidence to the private litigation that seeking civil compensation. The exact identification of the liability internalizes the negative externality of the

contaminated food, which, *ex ante*, provides appropriate incentives for operators to supply safe food.

The legislations on food traceability in E.U. have changed significantly to assure safe food instead of prompting the industry due to the crisis of BSE. GFL was enacted in 2002 and adopts a functional approach and tries to cover every step in the supply chain, ñfrom farm to forkò, comprehensively and integratedly to maintain food safety. GFL requires that the scientific instrument of risk analysis should be applied to achieve the ends of safe food, and the independent agency EFSA is created to take the responsibility of carrying out the function of risk assessment and risk communication. When the scientific evidence is not conclusive, the precautionary principle applies, which reflects that the Community has placed the protection of human health over economic interests of the food industry. According to Section 6.4 of the Communication from the Commission on the precautionary principle, when there is a positive list, the substance is deemed hazardous until the business community proves its safety, whereas such *a priori* approval procedures do not exist, then the burden of proof that the substance is risky lies on the consumer association, or public authorities.

In addition, GFL mandates the establishment of the traceability system among food operators. Special Community regulations on the beef industry, fishery and aquaculture products, GM food and feed are enacted respectively. These regulations provide detailed requirements for operators to collect and record information of every step of the supply chain and the labeling the products. The system is manageable and enforceable. Furthermore, according to the ñquality-geography nexusò, the quality of the foodstuffs is determined by the geographical characteristics and the human factors, and hence the *sui generis* system of GI protections, including the ñdesignation of originò and ñgeographical indicationò, is established in Europe. GI protection is expected to achieve two important policy goals: first, it provides information for the original place of the product also conveys important information for consumers,

second, it grants collective monopoly power to the firms located in the rural regions, which makes it possible for the small and medium enterprises to charge rent embedded in the appellation, leading to attractive life in rural area.

The food safety problem in China has its unique features and transplanting the European regulatory system completely is not suitable. After around thirty yearsô high growth, the issue of food security, *i.e.* the problem of providing enough food to its people, is solved in most regions in China, which makes it different from other developing countries that are struggling to feed its people. In addition, the problem also differs from that in E.U., which usually concerns about the problem originating from applications of new technologies, new crafts, and new materials to agriculture and food manufacturing. In contrast, the food safety problems in China are mainly concerned with the incidents related to microorganisms, toxic plants and animals, and chemical contamination, illegal food additives and contamination with environmental hazards.

The newly enacted FSL was drafted towards ensuring safe food to consumers and a reformed regulatory framework is under construction. The State Councilôs Food Safety Committee is created to lead the food safety management and makes national plans for food safety regulation. This changes the prior situation that the regulatory duties are divided among various public agencies, which monitor the segmented part of food production and transportation in the supply chain. The former regulatory framework is sure to leave gaps and overlaps of regulations and is regarded as the major cause for repeated food safety crisis. In addition, every participant along the food supply chain is assigned with the responsibility of ensuring the safe provision of foodstuffs. A national recall system of unsafe food is also established and administrated by AQSIQ to mitigate the potential adverse effects of unsafe food. The system cannot efficiently function without the traceability system to provide fundamental information needed.

Following the best practice of the scientific food safety regulation, FSL also mandates the application of risk assessment instrument. In 2011, a new independent agency, the Chinaôs National Center for Food Safety Risk Assessment, is created to administer the national risk assessments system, which shares the similar responsibilities of EFSA. However, risk communication is not well performed in China and transparency of food safety regulation is low. There is no systematic communication between government and consumers, except for major food safety crises. Public agencies possess significant monopoly power over the food safety information and the regional government would like to distort information disclosure once the risk breaks out. MOH will weigh the potential risks against the existing scientific evidence and carry out the function of risk management. If the risk assessment finds that the food is unsafe, the relevant public agencies will intervene and terminate the production. If it is proved that the national standards are inappropriate, MOH will start drafting the new safety standards. However, the process is not purely scientific and prone to political influence.

FSL explicitly mandates a reform of the national food safety standards and delegates the power of initiating a unified system to the MOH. To consolidate different standards, the guiding principle is that the levels of contaminants should be kept as low as possible and be safe to the general public and the safe levels of the contaminants are calculated according to the dietary structure and take the total exposure into consideration. The number of new national food safety standards released from 2010 when the FSL was enacted to 2013 is around 303. However, there is still significant inconsistency among standards drafted by different public agencies.

To supplement the overall reform of the food safety regulation, China has already accelerated the pace of building its traceability system. In February 1st, 2015, the Central Committee of the Communist Party of China and the State Council jointly released the first policy document, *The Notice on Strengthening the Reform and Speeding up the Modernization of the Agricultural Industry*, which places the

traceability system and the national platform for food safety and agricultural products as the key to improvement of food safety. China has a relatively short history dealing with traceability system compared to the well-established system in both U.S. and U.K. The traceability system is not mandated by FSL and mainly adopted by business operators for commercial reasons. Most of the established traceability system along the supply chain is still in rudimentary status and need further development. There are three public authorities involved in regulating the traceability system. MOA regulates the traceability of agricultural products; MOC, together with the MOF, regulates the meat and vegetable industry; and AQSIQ regulates the market for import and export of aquatic products. The segmented regulatory system generates significant inconsistency in the regulation and compliance costs to enterprises.

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Although as documented and discussed in this dissertation, China has been learning from and catching up with the European food safety regulation, there is still significant improvements that could be made. It should at least increase the enforcement of laws and regulations and unify the segmented and multiple governmental regulations. The creation of a national traceability system will become a good opportunity for China to improve its food safety, as it will provide precious information needed by regulators, producers and consumers.

References

Agostino, M., & Trivieri, F. (2014). Geographical indication and wine exports. An empirical investigation considering the major European producers. *Food Policy, 46*, 22-36.

Ahumada, O., & Villalobos, J. R. (2009). Application of planning models in the agri-food supply chain: A review. *European Journal of Operational Research, 196*(1), 1-20.

Alemanno, A. (2006) The evolution of European food regulation - Why the European Food Safety Authority is not a EU-style FDA?. In C. Ansell & D. Vogel (Eds.), *What's the Beef? The Contested Governance of European Food Safety*.Cambridge, MA: MIT Press

Akerlof, G. A. (1970). The market for ólemonsô: quality uncertainty and the market mechanism. *Aug, 84*(3), 488-500.

Andre, V. (2014). Review and aalysis of current traceability practices. *FAO working paper*, available at http://www.fao.org/cofi/39777-03016d7904191838c67f5d7da55b3430f.pdf.

Anker, H. T., & Grossman, M. R. (2009). Authorization of genetically modified organisms: precaution in US and EC Law. *European Food and Feed Law Review, 2009*(1), 3-22.

Antle, J. M. (1996). Efficient food safety regulation in the food manufacturing sector. *American Journal of Agricultural Economics*, 78(5), 1242-1247. doi: 10.2307/1243500

Article Numbering Center of China (2011). The application of the food safety traceability system of vegetables, fruits and other agricultural products in Shandong Province. *China Food Safety*, 6, 69-71.

Bai, L., Ma, C., Gong, S., & Yang, Y. (2007). Food safety assurance systems in China. *Food Control*, 18(5), 480-484. doi: http://dx.doi.org/10.1016/j.foodcont.2005.12.005

Bai, L., Ma, C., Yang, Y., Zhao, S., & Gong, S. (2007). Implementation of HACCP system in China: A survey of food enterprises involved. *Food Control, 18*(9), 1108-1112.

Balzano, J. (2012). China's food safety law: Administrative innovation and institutional design in comparative perspective. *Asian-Pacific Law & Policy Journal, 13*, 23-80.

Banister, J., Bloom, D., & Rosenberg, L. (2010). Population aging and economic growth in China. *PGDA Working Paper No. 53*, available at http://www.hsph.harvard.edu/pgda/working.htm

Banterle, A., & Cavaliere, A. (2014). Is there a relationship between product attributes, nutrition labels and excess weight? Evidence from an Italian region. *Food Policy, 49*, 241-249.

Barlow, S., Chesson, A., Collins, J., Dybing, E., Flynn, A., Fruijtier-Pölloth, C., . . . Le Neindre, P. (2007). Introduction of a qualified presumption of safety (QPS) approach for assessment of selected microorganisms referred to EFSA. Opinion of the Scientific Committee. *EFSA Journal, 587*, 1-16.

Bashaw, B. M. (2008). Geographical indications in China: Why protect GIs with both trademark law and AOC-type legislation. *Pac. Rim L. & Pol'y J., 17*, 73-102.

Becker, G. S. (1968). Crime and punishment: An economic approach. *Journal of Political Economy*, 76(2), 169-217.

Beekman, V. (2008). Consumer rights to informed choice on the food market. *Ethical Theory and Moral Practice, 11*(1), 61-72.

Bertolini, M., Bevilacqua, M., & Massini, R. (2006). FMECA approach to product traceability in the food industry. *Food Control, 17*(2), 137-145.

Beulens, A. J. M., Broens, D.-F., Folstar, P., & Hofstede, G. J. (2005). Food safety and transparency in food chains and networks Relationships and challenges. *Food Control*, 16(6), 481-486. doi: http://dx.doi.org/10.1016/j.foodcont.2003.10.010

Bollen, A. F., Riden, C. P., & N.R., C. (2007). Agricultural supply system traceability, Part I: Role of packing procedures and effects of fruit mixing. *Biosystems Engineering, 98*, 391-400.

Borit, M., & Olsen, P. (2012). Evaluation framework for regulatory requirements related to data recording and traceability designed to prevent illegal, unreported and unregulated fishing. *Marine Policy, 36*(1), 96-102. doi: http://dx.doi.org/10.1016/j.marpol.2011.03.012

Buhr, B. L. (2003). Traceability and information technology in the meat supply chain: implications for firm organization and market structure. *Journal of Food Distribution Research, 34*(3), 13-26.

Cai, C. (2013). Summary of Chinese research on pesticides and health. *Report prepared for the Social Science Research Council*. Working Paper.

Calaguas, M. J. (2005). Rose by any other name: Protecting geographical indications for wines and spirits in China, *Loyola University Chicago International Law Review*, 3, 257-279.

Canavari, M., Centonze, R., Hingley, M., & Spadoni, R. (2010). Traceability as part of competitive strategy in the fruit supply chain. *British Food Journal, 112*(2), 171-186.

Cao, L., Tian, W., Wang, J., Malcolm, B., Liu, H., & Zhou, Z. (2013). Recent food consumption trends in China and trade implications to 2020. *Australasian Agribusiness Review*, 21, 15-44.

Carriquiry, M., & Babcock, B. A. (2007). Reputations, market structure, and the choice of quality assurance systems in the food industry. *American Journal of Agricultural Economics, 89*(1), 12-23.

Carter, C., Zhong, F., & Zhu, J., (2012). Advances in Chinese agriculture and its global implications. *Applied Economic Perspectives and Policy*, 34, 1-36.

Caswell, J. A., & Mojduszka, E. M. (1996). Using informational labeling to influence the market for quality in food products. *American Journal of Agricultural Economics*, 1248-1253.

Chalmers, Damian. (2003). "Food for Thought": Reconciling European risks and traditional ways of life. *Modern Law Review*, 66(4), 532ï 562.

Chen, D. and Deng, H. (2004). Study on the legislation of genetically modified food safety in China, *Journal of Chongqing University* (Social Sciences Edition), 10 (3), 103-106 (in Chinese).

Chen, N. (2013). Heavy metal pollution in China: Implications for food safety. *Report prepared for the Social Science Research Council*. Working Paper.

Cheng, H. (2012). Cheap capitalism: A sociological study of food crime in China. *British Journal of Criminology*, 52, 254-273.

Cheng, M. J., & Simmons, J. E. L. (1994). Traceability in manufacturing systems. *International Journal of Operations & Production Management, 14*(10), 4-16. doi: doi:10.1108/01443579410067199

Cope, S., Frewer, L., Houghton, J., Rowe, G., Fischer, A., & De Jonge, J. (2010). Consumer perceptions of best practice in food risk communication and management: Implications for risk analysis policy. *Food Policy, 35*(4), 349-357.

Costa, C., Antonucci, F., Pallottino, F., Aguzzi, J., Sarriá, D., & Menesatti, P. (2013). A review on agri-food supply chain traceability by means of RFID technology. *Food and Bioprocess Technology, 6*(2), 353-366. doi: 10.1007/s11947-012-0958-7

Coutrelis, N. (2005). European Union food law update. *J. Food L. & Pol'y*, 1, 219-238.

Coutrelis, N., & Corre, P. Y. (2011). Protection of a name registered as a protected geographical indication (PGI) under the simplified procedure against a trade mark, *Eur. Food & Feed L. Rev.*, 116-120.

Czarnezki, J., Lin, Y., & Cameron, F. (2012). Global environmental law: Food safety & China. *Geo. Int'l Envtl. L. Rev., 25*, 261-287.

Dabbene, F., Gay, P., & Tortia, C. (2014). Traceability issues in food supply chain management: a review. *Biosystems Engineering, 120*, 65-80.

Dai, Y., Kong, D., & Wang, M. (2013). Investor reactions to food safety incidents: Evidence from the Chinese milk industry. *Food Policy, 43*, 23-31.

Dai, Y. & Xu, H. (2008). Analysis on aromatic components of Longjing Tea using SPME-GC/MS methods. *Journal of Tea*, 34, 85-88 (in Chinese).

Denton, W. (2003). Tracefish: the development of a traceability scheme for the fish industry. In: Luten, J.B., Oehlenschläger, J., Ólafsdóttir, G. (Eds.), *Quality of Fish from Catch to Consumer: Labelling, Monitoring and Traceability*. Wageningen Academic Publishers, Wageningen, pp. 75ï 91.

Dentoni, D., Menozzi, D., & Capelli, M. G. (2012). Group heterogeneity and cooperation on the geographical indication regulation: The case of the ñProsciutto di Parmaò Consortium. *Food Policy, 37*(3), 207-216.

Dupuy, C., Botta-Genoulaz, V., & Guinet, A. (2005). Batch dispersion model to optimise traceability in food industry. *Journal of Food Engineering*, 70(3), 333-339.

Echols, M. A. (2003). Geographical indications for foods, TRIPS and the DOHA Development Agenda. *Journal of African Law, 47*(02), 199-220.

Enneking, U. (2004). Willingness-to-pay for safety improvements in the German meat sector: the case of the Q&S label. *European Review of Agricultural Economics, 31*(2), 205-223.

European Commission (2002). Risk assessment of food borne bacterial pathogens: Quantitative methodology relevant for human exposure assessment, available at http://ec.europa.eu/food/fs/sc/ssc/out252_en.pdf.

FAO/WHO, Risk management and food safety. *FAO food and nutrition paper NO. 65*. Food and Agriculture Organization of the United Nations, Rome, Italy, 1997.

Feng, J., Fu, Z., Wang, Z., Xu, M., & Zhang, X. (2013). Development and evaluation on a RFID-based traceability system for cattle/beef quality safety in China. *Food Control, 31*(2), 314-325. doi: http://dx.doi.org/10.1016/j.foodcont.2012.10.016

Feng, S. (2008). Research on the product specification of EU geographical indication, *Hebei Law Science*, 26, 165-168.

Fortin, N. D. (2003). Hang-up with HACCP: The resistance to translating science into food safety law, The. *Food & Drug Law Journal, 58-593*, 565.

Gale, H. F., & Hu, D. (2012). Food safety pressures push integration in China's agricultural sector. *Am. J. Agr. Econ., 94*(2), 483-488. doi: 10.1093/ajae/aar069.

Gelpí, Emilio, Manuel Posada de la Paz, Benedetto Terracini, Ignacio Abaitua, Agustín Gómez de la Cámara, Edwin M. Kilbourne, Carlos Lahoz, et al. (2002). The Spanish toxic oil syndrome 20 years after its onset: A multidisciplinary review of scientific knowledge. *Environmental Health Perspectives*, 110(5), 457ï 464. doi:10.1289/ehp.02110457.

Girela, M. A. R. (2006). risk and reason in the European Union Law. *Eur. Food & Feed Law. Review*, 270-285.

Golan, E. H., Krissoff, B., & Kuchler, F. (2004). Food traceability: One ingredient in a safe and efficient food supply. *Information and Innovation Strengthen Food Safety, 2004*(2), 14-21.

Goodburn, K. (2001). EU Food law: A practical guide. in Kaarin Goodburn (Ed). *Food Science, Technology and Nutrition*, Woodhead Publishing.

Grunert, K. G. (2005). Food quality and safety: consumer perception and demand. *Eur. Rev. Agric. Econ., 32*(3), 369-391. doi: 10.1093/eurrag/jbi011

Gutierrez, E. (2005). Geographical indicators: a unique European perspective on intellectual property. *Hastings Int'l & Comp. L. Rev., 29*, 29-50.

Hall A. D. (1989). *Metasystems methodology: A new synthesis and unification*, *Pergamon Press*.

Hawkes, C. (2008). Agro-food industry growth and obesity in China: What role for regulating food advertising and promotion and nutrition labelling?. *Obesity Reviews*, 9(S1), 151-161.

He, P. & Chen, P. (2014). Study on causes of slow progress in promoting the application of food traceability system in China, *Asian Agricultural Research*, (6), 87-93.

He, W., Zhou, J., Cheng, H., Wang, L., Wei, K., Wang, W., & Li, X. (2012). Validation of origins of tea samples using partial least squares analysis and Euclidean distance method with near-infrared spectroscopy data. Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy, 86, 399-404.

Hobbs, J.E. (2002). Consumer demand for traceability. *International Agricultural Trade Research Consortium, working paper #03-1*.

Hofstede, G. J. (2002). Transparency in netchains, in Evert van Amerongen et al. (Eds.), *The Challenge of Global Chains* (pp. 73ï 89). Wageningen: Wageningen Academic Publishers.

Hölmstrom, B. (1979). Moral hazard and observability. *The Bell Journal of Economics, 10*(1), 74-91. doi: 10.2307/3003320

Handler, M. (2006). The WTO geographical indications dispute. *The Modern Law Review, 69*(1), 70-80.

Harrington, R. (2006). Trading health for economics: Commission of the European Communities v. Kingdom of Denmark. *Loy. LA Int'l & Comp. L. Rev., 28*, 351.

Heald, P. J. (1996). Trademarks and geographical indications: exploring the contours of the TRIPS Agreement. *Vand. J. Transnat'l L., 29*, 635-660.

Hennessy, D. A. (1996). Information asymmetry as a reason for food industry vertical integration. *American Journal of Agricultural Economics, 78*(4), 1034-1043. doi: 10.2307/1243859

Henson, S., & Caswell, J. (1999). Food safety regulation: an overview of contemporary issues. *Food Policy, 24*(6), 589-603. doi: http://dx.doi.org/10.1016/S0306-9192(99)00072-X

Hobbs, J. E. (2004). Information asymmetry and the role of traceability systems. *Agribusiness, 20*(4), 397-415.

Holdaway, J. & Husain, L. (2014). Food safety in China: A mapping of problems, governance and research, *Report prepared for the Social ScienceResearch Council.*

Holtkamp, N., Liu, P., & McGuire, W. (2014). Regional patterns of food safety in China: What can we learn from media data? *China Economic Review*, 30(0), 459-468.

Hood, Christopher, Rothstein, Henry, & Baldwin, Robert (2001). *The government of risk: Understanding risk regulation regimes*. Oxford: Oxford University Press.

Hoornstra, E., & Notermans, S. (2001). Quantitative microbiological risk assessment. *International Journal of Food Microbiology, 66*(1), 21-29.

ISO-22005:2007. (2007). *Traceability in the feed and food chain: General principles and basic requirements for system design and implementation*. International Organization for Standardization.

Ji, R. (2009). Study on Chinaôs food safety standards in food safety law, *Journal of Henan Administrative Institute of Politics and Law*, 04, 122-127 (in Chinese).

Jia, C., & Jukes, D. (2013). The national food safety control system of China: A systematic review. *Food Control, 32*(1), 236-245. doi: http://dx.doi.org/10.1016/j.foodcont.2012.11.042

Jiang, H. (2011). The weakness and possible solutions of food safety regulation in China, *Science*

of Law (Journal of Northwest University of Political Science and Law), 6, 154-162 (in Chinese).

Jiang, X., Dong, R., & Zhao, R. (2011). Meat products and soil pollution caused by livestock and poultry feed additive in Liaoning, China. *Journal of Environmental Sciences*, 23, S135-S137.

Jin, S., & Zhou, J. (2011). Adoption of food safety and quality standards by Chinaôs agricultural cooperatives. *Food Control, 22*(2), 204-208.

Jin, S., Zhou, J., & Ye, J. (2008). Adoption of HACCP system in the Chinese food industry: A comparative analysis. *Food Control, 19*(8), 823-828.

Joerges, C., & Neyer, J. (1997). From intergovernmental bargaining to deliberative political processes: The constitutionalisation of comitology. *European Law Journal*, 3, 273ï 299.

Jukes, D. (1995). Food law harmonization within Europeð a learning opportunity? *Food Control, 6*(5), 283-287.

Jukes, D. (1988). Food Law Harmonisation within the European Community. *British Food Journal,* 90 (4), 147ï 154. doi:http://dx.doi.org/10.1108/eb011820.

Karlsen, K. M., Dreyer, B., Olsen, P., & Elvevoll, E. O. (2012). Granularity and its role in implementation of seafood traceability. *Journal of Food Engineering, 112*(1ï 2), 78-85. doi: http://dx.doi.org/10.1016/j.jfoodeng.2012.03.025

Kehagia, O., Chrysochou, P., Chryssochoidis, G., Krystallis, A., & Linardakis, M. (2007). European consumers's percetions, definitions and expectations of traceability and the importance of labels, and the differences in these perceptions by product types. *Sociologia Ruralis, 47*(4), 400-416. doi: 10.1111/j.1467-9523.2007.00445.x

Kehoe, E. (2013). Combating the counterfeiting woes of the wine seller in China. *The Intellectual Property Law Review*, 53, 257-289.

Kim, H. M., Fox, M. S., & Gruninger, M. (1995). An ontology of quality for enterprise modelling. *In Proceedings of WET-ICE, Los Albamitos, CA, USA, IEEE*, 105-116.

Klein, B., & Leffler, K. B. (1981). The role of market forces in assuring contractual performance. *The Journal of Political Economy*, 615-641.

Lam, H.-M., Remais, J., Fung, M.-C., Xu, L., & Sun, S. S.-M. Food supply and food safety issues in China. *The Lancet, 381*(9882), 2044-2053. doi: http://dx.doi.org/10.1016/S0140-6736(13)60776-X

Lan, H., Huang, F., and Lin, Z. (2008). The design of food traceability system in the 2008 Beijing Olympic Games, *China Storage & Transport*, 5, 86-89 (in Chinese).

Lammerding, A. M., & Fazil, A. (2000). Hazard identification and exposure assessment for microbial food safety risk assessment. *International Journal of Food Microbiology, 58*(3), 147-157.

Latouche, K.,Rainelli,P., & Vermersch,D. (1998). Food safety issues and the BSE scare: Some lessons for the French case. *Food Policy,* 23(5),347ï 356.

LeCong, F. (2007). Food supplements directive: An attempt to restore the public confidence in food law. *Loy. LA Int'l & Comp. L. Rev., 29*, 105-120.

Leibovitch, E. H. (2007). Food safety regulation in the European Unionز Toward an unavoidable centralization of regulatory powers. *Texas International Law Journal*, 43, 429ï 450.

Leuschner, R. G., Robinson, T. P., Hugas, M., Cocconcelli, P. S., Richard-Forget, F., Klein, G., . . . Richardson, M. (2010). Qualified presumption of safety (QPS): a generic risk assessment approach for biological agents notified to the European Food Safety Authority (EFSA). *Trends in Food Science & Technology, 21*(9), 425-435.

Li, K. (2009). A comparative analysis of Food Safety Law and Food Hygiene Law. *Journal of Sichuan Administration College*, 03, 57-59 (in Chinese).

Liao, P.-A., Chang, H.-H., & Chang, C.-Y. (2011). Why is the food traceability system unsuccessful in Taiwan? Empirical evidence from a national survey of fruit and vegetable farmers. *Food Policy, 36*(5), 686-693.

Lin, Y.-Y., Zeng, H., Li, G.-C., & Ni, H.-G. (2010). Economic development is ultimate determinant of food safety: A case study of China. *Environmental Pollution*, 158(5), 1185-1188. doi: http://dx.doi.org/10.1016/j.envpol.2009.11.014

Liu, C. (2010). Obstacles of outsourcing imported food safety to China, The. *Cornell International Law Journal, 43*, 249-305.

Liu, W. J., Wei, Y. M., Han, J., & Luo, D. (2007). Food safety control system in China. *China Standardization Journal*, 4, 258-264 (in Chinese).

Liu, H., Kerr, W. A., & Hobbs, J. E. (2012). A review of Chinese food safety strategies implemented after several food safety incidents involving export of Chinese aquatic products. *British Food Journal, 114*(3), 372-386.

Liu, R., Pieniak, Z., & Verbeke, W. (2013). Consumers' attitudes and behaviour towards safe food in China: A review. *Food Control, 33*(1), 93-104.

Liu, R., Pieniak, Z., & Verbeke, W. (2014). Food-related hazards in China: Consumers' perceptions of risk and trust in information sources. *Food Control*, 46(0), 291-298. doi: http://dx.doi.org/10.1016/j.foodcont.2014.05.033

Liu, S., Xie, Z., Zhang, W., Cao, X., & Pei, X. (2013). Risk assessment in Chinese food safety. *Food Control, 30*(1), 162-167. doi: http://dx.doi.org/10.1016/j.foodcont.2012.06.038

Liu, Z., Zhang, G., & Zhang, X. (2014). Urban street foods in Shijiazhuang city, China: Current status, safety practices and risk mitigating strategies. *Food Control*, 41(0), 212-218. doi: http://dx.doi.org/10.1016/j.foodcont.2014.01.027

Lok, C., & Powell, D. (2005). *The Belgian Dioxin Crisis of the summer of 1999 : A case study in crisis communications and mnagement*. Guelph: University of Guelph, 2000.

Loureiro, M. L., & Umberger, W. J. (2007). A choice experiment model for beef: What US consumer responses tell us about relative preferences for food safety, country-of-origin labeling and traceability. *Food Policy, 32*(4), 496-514.

Lu, D. (2010). The Q&A about the regulation of the certification mark of Longjing Tea. China Tea, 1, 10-11 (in Chinese).

Lu, D. & Mao, Z. (2011). Empirical and positive analysis of Longjing tea industry from perspective of geographical indications. Acta Agriculturae Zhejiangensis, 23, 41-45 (in Chinese).

Lu, F., & Wu, X. (2014). China food safety hits the ñgutterò. *Food Control*, 41(0), 134-138. doi: http://dx.doi.org/10.1016/j.foodcont.2014.01.019

Lu, Y., Song, S., Wang, R., Liu, Z., Meng, J., Sweetman, A. J., Jenkins, A., Ferrier, R., Li, H., Luo, W., & Wang, T. (2015). Impacts of soil and water pollution on food safety and health risks in China. *Environment International*, 77(0), 5-15.

Lyon, J. D. (1998a). Coordinated food systems and accountability mechanisms for food safety: A law and economics approach. *Food & Drug Law Journal, 53*, 729-776.

Lyon, J. D. (1998b). Coordinated food systems and accountability mechanisms for food safety: A law and economics approach. *Food & Drug Law Journal, 53*, 729.

Mérel, P., & Sexton, R. J. (2012). Will geographical indications supply excessive quality? *European Review of Agricultural Economics, 39*(4), 567-587. doi: 10.1093/erae/jbr056

Majone, G. (2002). The precautionary principle and its policy implications. *JCMS: Journal of Common Market Studies, 40*(1), 89-109. doi: 10.1111/1468-5965.00345

Maldonado-Siman, E., Bai, L., Ramírez-Valverde, R., Gong, S., & Rodríguez-de Lara, R. (2014). Comparison of implementing HACCP systems of exporter Mexican and Chinese meat enterprises. *Food Control, 38*, 109-115.

Manzini, R., & Accorsi, R. (2013). The new conceptual framework for food supply chain assessment. *Journal of Food Engineering, 115*(2), 251-263. doi: http://dx.doi.org/10.1016/j.jfoodeng.2012.10.026

Marette, S., Clemens, R., & Babcock, B. (2008). Recent international and regulatory decisions about geographical indications. *Agribusiness, 24*(4), 453-472.

Mazzocchi, M., & Traill, W.B. (2009). *Fat Economics*. New York: Oxford University Press.

McEntire, J., & Boateng, A. (2012). Industry challenge to best practice risk communication. *Journal of food science, 77*(4), R111-R117.

Menapace, L., & Moschini, G. (2012). Quality certification by geographical indications, trademarks and firm reputation. *European Review of Agricultural Economics, 39*(4), 539-566. doi: 10.1093/erae/jbr053

Mol, A. P. (2014). Governing China's food quality through transparency: A review. *Food Control, 43*, 49-56.

Monten, L. (2006). Geographical indications of origin: Should they be protected and why? An analysis of the issue from the US and EU perspectives. *Santa Clara Computer & High Tech. Law Journal, 22*, 315-841.

Moschini, G., Menapace, L., & Pick, D. (2008). Geographical indications and the competitive provision of quality in agricultural markets. *Am. J. Agr. Econ., 90*(3), 794-812. doi: 10.1111/j.1467-8276.2008.01142.x

Murphy, K. M. (2003). Conflict, confusion, and bias under TRIPs Articles 22-24. *Am. U. Int'l L. Rev., 19*(5), 1181-1230.

National Advisory Committee on Microbiological Criteria for Foods (1992). Hazard analysis and critical control point system. *International Journal of Food Microbiology*, 16, 1-23.

Nelson, P. (1970). Information and consumer behavior. *The Journal of Political Economy*, 78(2),311-329.

Ni, H.-G., & Zeng, H. (2009). Law enforcement is key to China's food safety. *Environmental Pollution, 157*(7), 1990-1992. doi: http://dx.doi.org/10.1016/j.envpol.2009.02.002

Ortega, D. L., Wang, H. H., & Widmar, N. J. O. (2014). Welfare and Market Impacts of Food

Safety Measures in China: Results from Urban Consumers' Valuation of Product Attributes. *Journal of Integrative Agriculture*, 13(6), 1404-1411. doi: http://dx.doi.org/10.1016/S2095-3119(13)60676-0

Pagnattaro, M. A., & Peirce, E. R. (2010). From China to Your Plate: An Analysis of New Regulatory Efforts and Stakeholder Responsibility to Ensure Food Safety. *Geo. Wash. Int'l L. Rev., 42*, 1-56.

Peets, S., (2009). Specification, design and evaluation of an automated agrochemical traceability system (Doctoral Dissertation). Retrieved from *Cranfield Collection of E-Research*, available at http://dspace.lib.cranfield.ac.uk/handle/1826/4495.

Pei, X., Tandon, A., Alldrick, A., Giorgi, L., Huang, W., & Yang, R. (2011). The China melamine milk scandal and its implications for food safety regulation. *Food Policy, 36*(3), 412-420. doi: http://dx.doi.org/10.1016/j.foodpol.2011.03.008

Pierson, M.D., & Corlett, D. (1992). *HACCP: Principles and applications*. New York: Van Nostrand Reinhold.

Popper, D. E. (2007). Traceability: Tracking and privacy in the food system. *Geographical Review, 97*(3), 365-388. doi: 10.2307/30034177

Pouliot, S., & Sumner, D. A. (2008). Traceability, liability, and incentives for food safety and quality. *American Journal of Agricultural Economics, 90*(1), 15-27. doi: 10.2307/30139488

Profeta, A., Balling, R., Schoene, V., & Wirsig, A. (2009). The protection of origins for agricultural products and foods in Europe: status quo, problems and policy recommendations for the Green Book. *The Journal of World Intellectual Property, 12*(6), 622-648.

Qi, L., Zhang, J., Xu, M., Fu, Z., Chen, W., & Zhang, X. (2011). Developing WSN-based traceability system for recirculation aquaculture. *Mathematical and Computer Modelling, 53*(11), 2162-2172.

Qian, Guixia, Guo, Xiaochuan,Wu, Jianguo, and Guo, Jianjun (2010). The root cause of Chinaôs dairy industry crisis and countermeasures analysis. *Issues in Agricultural Economy*, 03, 30-36 (in Chinese).

Rangnekar, D. (2004). The socio-economics of geographical indications. *UNCTAD-ICTSD Project on IPRs and Sustainable Development, Issue Paper*(8).

Ratescu, I. (2010). Safe Use of Food Additives under EU Law. *Eur. J. Risk Reg., 4*, 401-404.

Recuerda, M. A. (2008). Dangerous interpretations of the precautionary principle and the foundational values of European Union Food Law: Risk versus risk. *J. Food L. & Pol'y, 4*, 1.

Regattieri, A., Gamberi, M., & Manzini, R. (2007). Traceability of food products: General framework and experimental evidence. *Journal of Food Engineering, 81*, 347-356.

Resende-Filho, M. A., & Hurley, T. M. (2012). Information asymmetry and traceability incentives for food safety. *International Journal of Production Economics, 139*(2), 596-603. doi: http://dx.doi.org/10.1016/j.ijpe.2012.05.034

Ropkins, K., & Beck, A. J. (2000). Evaluation of worldwide approaches to the use of HACCP to control food safety. *Trends in Food Science & Technology, 11*(1), 10-21.

Rotaru, G., & Borda, D. (2007). Safety models: HACCP and risk assessment *Food Safety: A Practical and Case Study Approach, McElhatton A. and Marshall R.J. (eds)* (pp. 225-238): Springer.

Ruiz-Garcia, L., & Lunadei, L. (2011). The role of RFID in agriculture: Applications, limitations and challenges. *Computers and Electronics in Agriculture, 79*(1), 42-50.

Sahin, E., Dallery, Y., & Gershwin, S. (2002). Performance evaluation of a traceability system. In: *Proceedings of IEEE International Conference on Systems, Man and Cybernetics*, Vol. 3, ISSN: 1062-922X. 210ï 218.

Sarac, A., Absi, N., & Dauzère-Pérès, S. (2010). A literature review on the impact of RFID technologies on supply chain management. *International Journal of Production Economics, 128*(1), 77-95. doi: http://dx.doi.org/10.1016/j.ijpe.2010.07.039

Scarpa, R., Philippidis, G., & Spalatro, F. (2005). Product-country images and preference heterogeneity for Mediterranean food products: A discrete choice framework. *Agribusiness, 21*(3), 329-349.

Schwägele, F. (2005). Traceability from a European perspective. *Meat science, 71*(1), 164-173.

Schwemer, S. F. (2012). Food for thought-revisiting the rationale of law-based food origin protection. *Eur. Food & Feed L. Rev.*, 134-142.

Seal, B. (2004). Consorzio del Prosciutto di Parma & Salumifico S. Rita SpA v. Asda Stores Ltd. & Hygrade Foods Ltd.: Classic protectionism: Thin ham provides thick protection for Member State domestic goods at the expense of the European Common Market. *Tul. J. Int'l & Comp. L., 12*, 545.

Serra, J., Domenech, E., Escriche, I., & Martorell, S. (1999). Risk assessment and critical control

points from the production perspective. *International Journal of Food Microbiology, 46*(1), 9-26.

Shan, L., Wu, L., & Xu, L. (2011). Investigations on factors impacting corporationsô invest intension and the level of investment to implement food traceability system, *Journal of South China Agricultural University* (Social Science Edition), 4, 85-92 (in Chinese).

Shanahan, C., Kernan, B., Ayalew, G., McDonnell, K., Butler, F., & Ward, S. (2009). A framework for beef traceability from farm to slaughter using global standards: An Irish perspective. *Computers and Electronics in Agriculture, 66*(1), 62-69. doi: http://dx.doi.org/10.1016/j.compag.2008.12.002

Shao, Y., Wang, J., Chen, X., & Wu, Y. (2014). The consolidation of food contaminants standards in China. *Food Control, 43*(0), 213-216. doi: http://dx.doi.org/10.1016/j.foodcont.2014.03.017

Shleifer, A. (2005). Understanding regulation. *European Financial Management*, 11(4), 439-451. doi: 10.1111/j.1354-7798.2005.00291.x

Song, M., Liu, L. J., Wang, Z., & Nanseki, T., 2008. Consumers' attitudes to food traceability system in China : Evidences from the pork market in Bijing. *Journal of the Faculty of Agriculture, Kyushu University,* 53(2), 569-574.

Sperber, W. H. (2001). Hazard identification: from a quantitative to a qualitative approach. *Food Control, 12*(4), 223-228. doi: http://dx.doi.org/10.1016/S0956-7135(00)00044-X

Starbird, S. A. (2005). Moral hazard, inspection policy, and food safety. *American Journal of Agricultural Economics, 87*(1), 15-27.

Starbird, S. A., & Amanor-Boadu, V. (2006). Do Inspection and Traceability Provide Incentives for Food Safety? *Journal of Agricultural and Resource Economics, 31*(1), 14-26. doi: 10.2307/40987303

Storøy, J., Senneset, G., Forås, E., Olsen, P., Karlsen, K. M., & Frederiksen, M. (2008). Improving traceability in seafood production. In T. E. Børresen (Ed.), *Improving seafood products for the consumer, part VI seafood traceability to regain consumer confidence* (pp. 516-538). Cambridge: Woodhead Publishing Limited.

Storøy, J., Thakur, M., & Olsen, P. (2013). The TraceFood frameworkï principles and guidelines for implementing traceability in food value chains. *Journal of Food Engineering, 115*(1), 41-48.

Sun, C., Ji, Z., Yang, X., Han, X., & Wang, Z. (2007). A traceability system for beef products based on radio frequency identification technology in China. *New Zealand Journal of*

Agricultural Research, 50(5), 1269-1275.

Sun, X. (2010). On the weak points of food safety law and itôs countermeasures, *Legal Forum*, 25 (1), 105-111 (in Chinese).

Sykuta, M. (2005). Agricultural organization in an era of traceability. *Journal of agricultural and applied economics, 37*(2), 365.

Szajkowska, A. (2009). From mutual recognition to mutual scientific opinion? Constitutional framework for risk analysis in EU food safety law. *Food Policy, 34*(6), 529-538.

Szawlowska, K. (2004). Risk assessment in the European food safety regulation: Who is to decide whose science is better-Commission v. France and beyond. *German Law Journal, 5*, 1259.

Moe, T. (1998). Perspectives on traceability in food manufacture. *Trends in Food Science & Technology 9, 9*, 211-214.

Taghaboni-Dutta, F., & Velthouse, B. (2006). RFID technology is revolutionary: who should be involved in this game of tag? *The Academy of Management Perspectives, 20*(4), 65-78.

Thompson, D., & Ying, H. (2007). Food safety in China: new strategies. *Global Health Governance*, 2, 1-19.

Ugland, T., & Veggeland, F. (2006). Experiments in food safety policy integration in the European Union. *JCMS: Journal of Common Market Studies, 44*(3), 607-624.

Unnevehr, L. J., & Jensen, H. H. (1996). HACCP as a regulatory innovation to improve food safety in the meat industry. *American Journal of Agricultural Economics, 78*(3), 764-769. doi: 10.2307/1243301

U.S. Patent and Trademark Office (USPTO). (2006). Summary of the Report of the Panel (WT/DS174/R) of March 15, 2005, regarding the complaint by the United States against the European Communities on the protection of trademarks and geographical indications for agricultural products and foodstuffs. Washington, DC.

van der Meulen, B. (2009). Science based food law. *European Food and Feed Law Review, 2006*(1), 58-71.

van der Meulen, B. (2012). The core of food law: A critical reflection on the single most important provision in all of EU food law. *Eur. Food & Feed L. Rev.*, 117.

Van der Meulen, B. (2013). The structure of European Food Law. *Laws,* 2(2), 69ï 98. doi:10.3390/laws2020069. http://www.mdpi.com/2075-471X/2/2/69/.

Van der Muelen, B. M., & Freriks, A. A. (2006). Millefeuille-The emergence of a multi-layered controls system in the European food sector. *Utrecht L. Rev., 2*, 156.

Van Rijswijk, W., & Frewer, L. J. (2012). Consumer needs and requirements for food and ingredient traceability information. *International Journal of Consumer Studies, 36*(3), 282-290.

van Rijswijk, W., Frewer, L. J., Menozzi, D., & Faioli, G. (2008). Consumer perceptions of traceability: A cross-national comparison of the associated benefits. *Food Quality and Preference, 19*(5), 452-464. doi: http://dx.doi.org/10.1016/j.foodqual.2008.02.001

Van Rooij, B. (2006). Implementation of Chinese environmental law: regular enforcement and political campaigns. *Development and Change, 37*(1), 57-74.

Veeck, A., Yu, H., & Burns, A. C. (2010). Consumer risks and new food systems in urban China. *Journal of Macromarketing, 30*(3), 222-237.

Vos, E. (2000). EU food safety regulation in the aftermath of the BSE crisis. *Journal of Consumer Policy, 23*(3), 227-255.

Walker, E., Pritchard, C., & Forsythe, S. (2003). Hazard analysis critical control point and prerequisite programme implementation in small and medium size food businesses. *Food Control, 14*(3), 169-174.

Wang, C. (2009). On the protection of private rights to the geographic indication and choice of protection modes in China, *Northern Legal Science*, 17, 95-102 (in Chinese).

Wang, D., Wu, H., Hu, X., Yang, M., Yao, P., Ying, C., . . . Liu, L. (2010). Application of hazard analysis critical control points (HACCP) system to vacuum-packed sauced pork in Chinese food corporations. *Food Control, 21*(4), 584-591.

Wang, F., Zhang, J., Mu, W., Fu, Z., & Zhang, X. (2009). Consumersô perception toward quality and safety of fishery products, Beijing, China. *Food Control, 20*(10), 918-922. doi: http://dx.doi.org/10.1016/j.foodcont.2009.01.008

Wang, G., & Toulouse, I. (2010). Jinhua Ham, China. In: Lecoent, A., Vandecandelaere, E. and Cadilhon, J. (Eds.), *Quality Linked to Geographical Origin and Geographical Indications: Lessons Learned from Six Case Studies in Asia*. Food and Agriculture Organization of the United Nations, pp. 57-83.

Wang, H. & Qiao, J. (2011). Analyze on farmersô behavior and produce efficiency by participating in food safety traceability system case of vegetable farmers in Beijing. *Issues in Agricultural Economy*, 2, 45-51 (in Chinese).

Wang, L. & Huang, Z (2006). The debate on the models of protecting geographical indications and the legislative choices. *Journal of the East China University of Political Science and Law*, 49, 44-53 (in Chinese).

Wang, L., Wei, K., Cheng, H., He, W., Li, X., & Gong, W. (2014). Geographical tracing of Xihu Longjing tea using high performance liquid chromatography. *Food chemistry*, 146, 98-103.

Wang, M. C. (2006). Asian consciousness and interests in geographical indications, The Trademark Rep., 96, 906-942.

Wang, X., & Irina, K. (2007). Protection of Geographical Indications in China: Conflicts, Causes and Solutions. *The Journal of World Intellectual Property, 10*(2), 79-96. doi: 10.1111/j.1747-1796.2007.00315.x

Wang, X., Li, D., & Shi, X. (2012). A fuzzy model for aggregative food safety risk assessment in food supply chains. *Production Planning & Control, 23*(5), 377-395.

Wang, Z. (2009). On reform and perfection of the food recall system in China, Jurist, 3, 142-147 (in Chinese).

Wang, Z., Mao, Y., & Gale, F. (2008). Chinese consumer demand for food safety attributes in milk products. *Food Policy, 33*(1), 27-36. doi: http://dx.doi.org/10.1016/j.foodpol.2007.05.006

Winfree, J., & McCluskey, J. (2005). Colletive reputation and quality. *Amer. J. Agr. Econ, 87*(1), 206-213.

Wirthgen, A. (2005). Consumer, retailer, and producer assessments of product differentiation according to regional origin and process quality. *Agribusiness, 21*(2), 191-211.

Wu, L. H. and Xu, L. L. (2009). Food safety: Risk awareness and consumer behavior. *Consumer Economics*, 25 (2), 42ï 44.

Wu, L., Xu, L., Zhu, D., & Wang, X. (2012). Factors affecting consumer willingness to pay for certified traceable food in Jiangsu province of China. *Canadian Journal of Agricultural Economics/Revue canadienne d'agroeconomie, 60*(3), 317-333.

Wu, L., Zhang, Q., Shan, L., & Chen, Z. (2013). Identifying critical factors influencing the use of additives by food enterprises in China. *Food Control, 31*(2), 425-432. doi: http://dx.doi.org/10.1016/j.foodcont.2012.10.028

Wu, L., Zhong, Y., Shan, L., & Qin, W. (2013). Public risk perception of food additives and food scares. The case in Suzhou, China. *Appetite, 70*, 90-98.

Wu, L., & Zhu, D. (2014). *Food Safety in China: A Comprehensive Review*. Abingdon: CRC Press.

Wu, X., Ye, Y., Hu, D., Liu, Z., & Cao, J. (2014). Food safety assurance systems in Hong Kong. *Food Control, 37*(0), 141-145. doi: http://dx.doi.org/10.1016/j.foodcont.2013.09.025

Wu, Y., & Chen, Y. (2013). Food safety in China. *Journal of epidemiology and community health, 67*(6), 478-479.

Xiao, J., Yu, L., Chen, X., & Huang, B. (2004). Characteristics, use and outlook for HACCP. *Chinese Journal of Animal Quarantine, 21*(7), 2-4.

Xiao, P. (2011). China's milk scandals and its food risk assessment institutional framework. *Eur. J. Risk Reg., 3*, 397-406.

Xiao, P. (2012). China's food standardization system, its reform and remaining challenges. *Eur. J. Risk Reg., 4*, 507-520.

Xiong, B.-H., Fu, R.-T., Lin, Z.-H., Luo, Q.-Y., Liang, Y., & Pan, J.-R. (2010). A solution on pork quality traceability from farm to dinner table in Tianjin City, China. *Agricultural Sciences in China, 9*(1), 147-156.

Xu, L., Shan, L., Wu, L., 2011. Empirical analysis of farmer's perception and behavior in implementing agricultural products traceability system: Take apple planting farmers as an example. *Finance and Trade Research*, 5, 34-40 (in Chinese).

Xu, L., & Wu, L. (2010). Food safety and consumer willingness to pay for certified traceable food in China. *Journal of the Science of Food and Agriculture, 90*(8), 1368-1373. doi: 10.1002/jsfa.3985

Xue, J., & Zhang, W. (2013). Understanding China's food safety problem: An analysis of 2387 incidents of acute foodborne illness. *Food Control, 30*(1), 311-317. doi: http://dx.doi.org/10.1016/j.foodcont.2012.07.024

Yang, L., Qian, Y., Chen, C., & Wang, F. (2012). Assessing the establishment of agro-food control systems based on a relevant officialsô survey in China. *Food Control, 26*(2), 223-230. doi: http://dx.doi.org/10.1016/j.foodcont.2012.01.048

Yang, Z. (2008). Analysis about criminal protection for geographical indication right. *Law Science Magazine*, 06, 66-68 (in Chinese).

Yu, H. & Wang, J. (2007). Discrimination of LongJing green-tea grade by electronic nose. *Sensors and Actuators B: Chemical*, 122, 134-140.

Zan, Y., Lu, D. & Shang, J. (2012). The research on the traceability system based on the geographical indication of Longjing Tea. *Computer Knowledge and Technology*, 10, 5-7 (in Chinese).

Zhang, C., Bai, J., & Wahl, T. I. (2012). Consumers' willingness to pay for traceable pork, milk, and cooking oil in Nanjing, China. *Food Control, 27*(1), 21-28. doi: http://dx.doi.org/10.1016/j.foodcont.2012.03.001

Zhang, J., Liu, N., & Yang, J. (2005). Study on building and promoting the system of Chinaôs food security, *China Industrial Economy*, 203, 14-20 (in Chinese).

Zhang, L., Mol, A. P. J., He, G., & Lu, Y. (2010). An implementation assessment of China's Environmental Information Disclosure Decree. *Journal of Environmental Sciences, 22*(10), 1649-1656. doi: http://dx.doi.org/10.1016/S1001-0742(09)60302-8

Zhang, X., Feng, J., Xu, M., & Hu, J. (2011). Modeling traceability information and functionality requirement in export‐oriented tilapia chain. *Journal of the Science of Food and Agriculture, 91*(7), 1316-1325.

Zhang, X., Lv, S., Xu, M., & Mu, W. (2010). Applying evolutionary prototyping model for eliciting system requirement of meat traceability at agribusiness level. *Food Control, 21*(11), 1556-1562. doi: http://dx.doi.org/10.1016/j.foodcont.2010.03.020

Zhang, X., Zhang, J., Liu, F., Fu, Z., & Mu, W. (2010). Strengths and limitations on the operating mechanisms of traceability system in agro food, China. *Food Control, 21*(6), 825-829. doi: http://dx.doi.org/10.1016/j.foodcont.2009.10.015

Zhao, S. & Li, X. (2012). Discussion on the agricultural products brand and legal protection, *Tianjin Legal Science,* 109, 95-100 (in Chinese).

Zhao, X., Finlay, D. & Kneafsey, M. (2014). The effectiveness of contemporary Geographical Indications (GIs) schemes in enhancing the quality of Chinese agrifoods: Experiences from the field. *Journal of Rural Studies*, 36,77-86.

Zhou, G., Zhu, L., Ren, T., Zhang, L., & Gu, J. (1995). Geochemical characteristics affecting the cultivation and quality of Longjing Tea. *Journal of Geochemical Exploration*, 55(1): 183-191.

Zhou, J., Helen, J. H., & Liang, J. (2011). Implementation of food safety and quality standards: a case study of vegetable processing industry in Zhejiang, China. *The Social Science Journal, 48*(3), 543-552.

Zhou, J., Wang, Y., and Zhang S. (2011). Analysis of suppliersô behaviors in the vegetable safety traceability system. *Journal of Zhejiang University* (Humanities and Social Sciences

Edition), 2, 116-126 (in Chinese).

Ziegler, H., Osmond, C. B., Stichler, W., & Trimborn, P. (1976). Hydrogen isotope discrimination in higher plants: correlations with photosynthetic pathway and environment. *Planta*, 128, 85ï 92.