social sciences

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Food Safety in China: The Structure and Substantive Foci of an Emerging Field of Social Science Research

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Received: 16 May 2018; Accepted: 20 June 2018; Published: 26 June 2018

Abstract: This paper is the first to describe the structure and content of the English language social science literature on food safety in China. To do this research we systematically searched Web of Science and Scopus, the most comprehensive indexes, using the terms "Food Safety" AND "China" OR "Chinese". To focus our search results, we used the index features available on Web of Science and Scopus, and limited results to the English language, peer-reviewed journal articles, social sciences, and published in the period of 2009 to 2015. This resulted in 272 selected journal articles, with a final data set of 185 articles for review. A food safety system model we developed was used to classify and present the findings derived from content analysis of abstracts, titles, and keywords. Our findings show that the research reviewed is unevenly distributed across the components of the food safety system model. The greatest proportions of the literature reviewed focused on consumers, primary and secondary producers and products, and government legislators and regulators, respectively. Smaller proportions focused on food wholesalers, retailers, researchers, educators, and the media. Few of the articles reviewed used a model of the food safety system. None identified an explicit knowledge transfer strategy.

Keywords: food safety; food safety system; social sciences; literature mapping; abstract analysis; keyword analysis; China; NVivo Software

1. Introduction

Food safety is defined in at least three ways. First, it is defined as a characteristic of food that does not cause illness when consumed (US Department of Agriculture, Food Safety and Inspection Service 1999). Second, it is defined as an interdisciplinary scientific discipline describing processes for handling, storing, and preparing food that prevent foodborne illness (Definitions n.d.). The third definition conceptualizes food safety as a system of practices, including prevention, detection, surveillance, and control, designed to reduce to safe levels or eliminate biological, chemical, and physical hazards in food and water supplies (Association of State and Territorial Health Officials ASTHO).

The first definition is factual, but tautological. It is also silent on the means by which food safety is achieved. In contrast, the second definition addresses the issue of how food safety is achieved, but the assertion that food safety is an interdisciplinary scientific discipline seems more aspirational and reductionist than descriptive. For this paper we adopt the third definition. This definition has several important features: (1) It identifies three categories of food and water safety hazards (biological, chemical, physical); and (2) it identifies four complementary practices (prevention, detection, surveillance, and control) that are; (3) pursued systematically, (i.e., through a set of systematic

practices). See Table 1 for definitions of selected food safety concepts. Building on this definition, in Section 2 below, we introduce and briefly elaborate a food safety system model that we use as a heuristic device to structure and categorize the food safety research.

Table 1. Definitions of Selected Food Safety Systems Terms *.

Term	Definition
Hazards	Agents or elements that have potential to cause harm. In the context of food safety, these include biological, chemical, and physical agents/entities.
Risks	The probability that exposure to food safety hazards will cause illness or death.
Incidents	Cases where people encounter and interact with hazards.
Prevention	Efforts to reduce or eliminate encounters and interactions with hazards.
Detection	Efforts to identify food safety incidents.
Surveillance	Efforts to identify and track food safety hazards.
Control	Includes both (1) efforts to prevent hazards entering foods and food systems, and (2) interventions to mitigate harms when food safety incidents occur.

* Definitions are derived from a general reading of the literature.

This definition also highlights the fact that food safety is multi-dimensional. It consists of both scientific and technological dimensions, as well as socio-cultural and politico-economic dimensions. The scientific technical elements of food safety address issues of human nutrition and safe exposure levels to a wide variety of biological, chemical, and physical substances in food and food systems. It is equally apparent, however, that food safety also involves a variety of social, political, economic, cultural, legal, and behavioral dimensions related to the prevention, detection, surveillance, and control practices through which various food safety hazards and risks are identified and managed. These aspects of food safety are the research and educational domains of social sciences broadly conceptualized.

Using our food safety system model as a heuristic device, and literature mapping methods, this paper identifies and describes the structure and substantive themes that characterize the English language social science research on food safety in China published between 2009 and 2015. The paper consists of a total of six sections. In the second section following this introduction we address the questions "Why study food safety and why China?" In the third section we describe a food safety system model. This is followed by a description of the literature mapping method, the data used, and how it was collected and analyzed. The fifth section presents the findings and our discussion of them. The paper ends with a short conclusions section.

2. Food Safety: Why Study It? Why China?

Food safety, along with an array of other individual, community and environmental factors, is recognized by the World Health Organization (WHO) as a primary determinant of population health (World Health Organization WHO). Additionally, food safety is recognized as a factor affecting economic development and trade. Neither domestic nor international consumers knowingly purchase unsafe foods. This, of course, impedes economic trade and development, and, if governments are seen to have failed to meet their fiduciary obligations, it may also result in legitimation crises.

Recognition of both the economic and public health dimensions of food safety is necessary for a comprehensive understanding of food safety systems, their structure, functioning, and effects. In this section, we briefly describe the public health and economic development dimensions of food safety globally and for China in particular.

Globally the main demonstrated food safety hazards are either biological (bacteria, viruses, parasites) or chemical in nature. Infectious and toxic illnesses are the main types of foodborne illnesses.

The WHO estimates that consuming unsafe food causes approximately 600 million people to get ill and about 420,000 to die each year (World Health Organization WHO, p. 72).

This illness burden caused by unsafe food, however, is not evenly distributed geographically or demographically. Geographically, parts of sub-Saharan Africa carry the highest foodborne illness burden, followed by South East Asia, and the Eastern Mediterranean (World Health Organization WHO). Demographically, children carry the greatest illness burden. Children less than five years of age, for example, bear about 40% of this illness burden and, globally, 125,000 children are estimated to die annually from foodborne illnesses (World Health Organization WHO).

In the last decade or so, high profile and widely reported food safety issues in China have been a major source of concern both for China and its many trading partners. Since 2003, a number of food safety incidents have been reported, including contaminated baby formula (melamine in milk) (2004/2007, 2008), counterfeit alcoholic drinks (2004), use of gutter oil (2010, 2014), pesticide residue on vegetables (2006), contaminated meat and fish (2006, 2009, 2011, 2013), and recycled, out-of-date food (2013). Wikipedia reports 39 major food safety incidents in China between 2003 and 2015. (*Wikipedia*, s.v. Food Safety Incidents in China). The Chinese language website, *Throw it out the window* (http://www.zccw.info/), also provides an extensive list of food safety issues in China reported by the media dating back to 2004.

Of all the food safety incidents in China, the melamine contaminated baby formula scandal in 2008 was the most severe, affecting an estimated 300,000 babies and resulting in a reported 54,000 hospitalisation, and six deaths.

In terms of trade and economic development, in 2016, the value of the global agriculture and food industries was estimated to be about $8 trillion USD. In 2015, the total value of global food exports was estimated by the World Trade Organization (WTO) to be about $1.33 trillion USD (Plunkett Research Ltd. 2017).

China is both a significant importer and exporter of agricultural and food products. In 2015, the WTO estimated that China accounted for about 9% of world imports of agricultural products, and 4.6% of global exports of agricultural products (Plunkett Research Ltd. 2017).

The combined health and economic consequences of food safety incidents in China are not unique. All major food safety incidents can have a range of negative social and economic consequences, including lost trade and tourism, as well as straining health care systems (World Health Organization WHO; Munro et al. 2012; World Health Organization WHO).

In the following section, we briefly elaborate a food safety system model that we used heuristically to facilitate the mapping of the selected research literature.

3. Towards a Model of Food Safety Systems

As stated above, food safety is defined as "a systematic set of practices including prevention, detection, surveillance, and control designed to reduce to safe levels or eliminate biological, chemical, and physical hazards in food and water supplies" (Association of State and Territorial Health Officials ASTHO). Based on this definition we conceptualize food safety systems as consisting of two major interacting sub-systems, namely, food systems and food control systems.

Food systems include several interrelated elements, including: (1) Primary and secondary producers; (2) food transportation and storage; (3) marketing and sales (wholesale and retail); (4) food preparation and providers (e.g., restaurants, institutional food services, street vendors); and (5) home-based purchasers and consumers (Garnett and Wilkes 2014; Munro et al. 2012).

As indicated above, food production itself consists of two main sub-systems—primary and secondary production. Primary food production in turn consists of at least two main sub-systems—agriculture and aquaculture. Agriculture consists of numerous sub-sub-systems, such as grain production, vegetable and fruit production, livestock production, and poultry production to name a few. Similarly, aquaculture, also known as aqua farming, consists of sub-systems associated with both fresh water and salt water production of fish, crustaceans, mollusks, aquatic plants, and

other forms of aquatic life. Aquaculture is also distinguished from commercial fishing, which involves the harvesting of aquatic organisms living in the wild (*Wikipedia*, s.v. Aquaculture).

Secondary food production can also be conceived of in terms of the numerous sub-systems engaged in processing the various types of food produced by primary producers. The other elements of the food system—storage and transportation, marketing and sales, vendors, and consumers—also consist of various sub-systems each with their own elements, structures, functions, processes, and boundaries.

Food control systems are the second main sub-system making up food safety systems. The Food and Agriculture Organization (FAO) identifies five core functions of food control systems: Food legislation; food control management; food inspection; food control laboratories; and information, education, and communication (IEC) about the quality and safety of food (Food and Agriculture Organization FAO, p. xii; Jia and Jukes 2013).

To adequately perform these functions, food control systems consist of several inter-related elements, including: (1) Legislatures; (2) ministries; (3) regulatory and inspection agencies of several levels of government; (4) research and training institutions; (5) industry associations; (6) consumer associations; and (7) other agencies and organizations involved in establishing standards and ensuring the safety of the food supply (Munro et al. 2012, p. iii).

The complexity of an emerging global food safety system is increased by the involvement of several international organizations. At the center of the global food safety system is the United Nations and, specifically—the WHO and the FAO. Additionally, however, as mentioned above, it also includes other international organizations, such as the agricultural commodity producers' associations, food processing industry associations, consumer associations, research and educational organizations, and others.

Thus, for major food exporting and importing countries, like China, food safety control systems are unique and they exist at the intersection of public health, economic development, and trade policies and practices. Furthermore, they exist in complex networks of relationships involving national and various sub-national levels of government whose interests may not always be congruent. Additionally, food safety control systems involve relationships with the food safety control systems of trading partners, and a variety of international agreements.

The purpose of the model is to provide a data classification template for our research. It is important to note that the purpose of the model is not to provide a detailed description or assessment of the structure, functioning, and effects of China's food safety system, but rather to describe the form and general content of the English language social sciences research literature on food safety in China.

For data collection purposes, we condensed the preceding discussion into the following eight food safety system categories: (1) Primary producers, (2) manufacturers/processors/transporters, (3) wholesalers/retailers, (4) vendors of prepared foods (restaurants, street vendors), (5) home-based consumers, (6) legislators, regulators, standards organizations, consumer protection agencies, international organizations, (7) researchers and educators (including university education), and (8) the media. Where it was provided we also recorded the type of food discussed and the safety risk described by the authors.

4. Data and Methods

In this section, we describe, in general terms, the methods we used and we identify several other contexts in which they have been used. We then describe the data sources and search methods used, as well as the types of data collected and the data analysis techniques employed. Mapping academic literature using combinations of content analysis, systematic review protocols, bibliometric data analysis techniques, and qualitative and/or quantitative data analysis methods are well-accepted and widely used knowledge discovery techniques (Duke University, Medical Center & Archives 2018; Serenko 2013). For this study, we mapped the English language social sciences food safety research literature on China using content analysis to provide insights into its structure and content.

A systematic literature search resulted in no peer reviewed papers on food safety research using similar methods. Our search did reveal, however, a number of related, but distinctly different, approaches to food safety research. These included content analyses of food safety incidents (Liu et al. 2015) and food traceability (Ringsberg 2014), as well as an analysis of policy, news and organizational documents combined with informal interviews (Epstein 2014). We also found an in-depth analysis of oyster research (Guo et al. 2015), and co-citation patterns (Gong et al. 2013). Based on this, we are certain our paper makes a methodologically unique and substantively original contribution to understanding the evolving form and content of an emerging area of social science research.

In general, literature mapping methods have been used in three main ways. First, literature mapping has been used to identify and describe the growth of specific subjects, for example, knowledge management (Serenko 2013) and sustainability within retail management (Wiese et al. 2012). Second, literature mapping techniques have been used to identify the emergence of new, and the evolution of established, themes in specific journals, including education (Erduran et al. 2015), healthcare (Galer-Unti et al. 2004), and medical sociology (Seale 2008). Third, and focusing specifically on keyword analysis, we found studies that identified the most frequently cited subject terms (Ribière and Walter 2013), the narrow or broad influence of key subject terms (Leite et al. 2012), and the emergence of new subject areas within a discipline (Juvan et al. 2005). Categorizing keywords thematically to identify the form and content of research areas is an established method (Juvan et al. 2005; Seale 2008).

A sample of relevant articles for our study was found using the widely employed foundational search methods (Leite et al. 2012; Mao et al. 2016; Ribière and Walter 2013; Serenko 2013). Our initial search began January 2015 and ended March 2016, and consisted of a broad-based search of both the Web of Science and Scopus comprehensive indexes using the terms "Food Safety" and (China or Chinese). This resulted in an unmanageably large number of references.

The second stage of the search process involved using the index features available on Web of Science and Scopus to reduce the results to a manageable number. This included limiting results to the English language, peer-reviewed journal articles, social sciences, and a date range from 2009, when China's new food safety law was introduced (Petry and Bugang 2009), to 2015 inclusive.

The above procedures resulted in 272 journal articles selected for review. Reading the abstracts resulted in 87 duplicate or irrelevant articles being removed from the data set. The final data set consisted of 185 articles. Zotero bibliometric software was used to manage the data.

Our search strategy produced a sample rather than a complete collection of the interdisciplinary English language, social science food safety research literature on China. Our sample does not include grey literature or peer reviewed literature not included and classified as "social science" by the Scopus and Web of Science indexes. Web of Science and Scopus are the most comprehensive indexes and both are extensively used by others using related research methodologies.

In addition to abstracts, key words and article titles both bibliometric and substantive information also was collected. The bibliometric data consisted of: (1) Name[s] of author[s]; (2) title of the journal; and (3) year of publication. Other data collected when it was available from the abstracts included: (4) Data collection methods used by the researchers; (5) data analysis strategies and techniques; (6) identification of a theoretical framework from which testable hypotheses were derived; and (7) whether explicit reference was made to a knowledge transfer strategy.

The substantive information was recoded using the eight food safety system categories derived from the food safety model described in the preceding section. These were: (1) Primary producers, (2) manufacturers and processors and transporters, (3) wholesalers and retailers, (4) vendors of prepared foods (restaurants, institutional food services, street vendors, etc.), (5) home-based consumers, (6) legislators, regulators, standards organizations, consumer protection agencies, international organizations, (7) researchers and educators (including university education), and (8) the media and other sources of food safety information. We also recorded (9) the type of food involved in the food safety incident and (10) the safety hazard identified when it was available.

The 185 articles did not always provide an abstract or author supplied keywords. In cases where author provided keywords were unavailable, Web of Science and Scopus did provide keywords. Articles without abstracts or author provided keywords were not included in the respective analyses that used those data. The classified data sheets were then manually entered into both SPSS and Nvivo 11 for review and analysis of keywords based on the basic bibliometric data and the aforementioned food safety system classification scheme.

5. Findings and Discussion

In this section we present and discuss the results of the literature mapping process. The findings are based on manual and NVivo-based content analyses of abstracts, keywords, and titles of the 185 articles constituting our data set.

5.1. Bibliometric Information

Table 2 shows the number of articles that met both our search and inclusion criteria by publication year. A trend towards an increased number of published articles is evident. In 2009, 11 articles (5.9% of the total) were found. By 2015, this increased to 55 articles or 29.7% of the total number of articles. About half of all the articles used were published in the two most recent years of our search period.

Table 2. Number and percentage of articles published by year, 2009–2015.

Year	Number of Articles	Percent
2009	11	5.9
2010	19	10.3
2011	12	6.5
2012	26	14.1
2013	25	13.5
2014	37	20.0
2015	55	29.7
Total	185	100.0

Table 3 cross-tabulates the number of articles with the number of food safety system categories identified by year of publication. These data are based on a content analysis of the article abstracts. Most of the abstracts identify one element of our food safety system model as the focus of the research. This single element focus increased over the 2009 to 2015 time period. This suggests that systems models do not explicitly inform the reviewed research literature. It may also be the case, however, that the uneven form and content of social science abstracts results in information related to the use of analytical models being unevenly reported (Hartley and Betts 2009).

Table 3. Cross tabulation of publication year and the number of food safety system categories identified.

Year	Number of Food Safety System Categories Identified in Abstracts						Total
	1	2	3	4	5	6	
2009	7	3	1	0	0	0	11
2010	12	5	2	0	0	0	19
2011	8	2	1	1	0	0	12
2012	16	5	3	0	1	0	25
2013	16	6	2	1	0	0	25
2014	19	7	8	1	1	1	37
2015	35	15	3	2	1	0	56
Total	113	43	20	5	3	1	185

5.2. Food Safety Hazards

About 74% (137 articles) of the articles in our study identified the foods on which the research focused. We grouped these into eleven categories: Milk and dairy products; meat; fruit, and vegetables, green/organic foods; Genetically Modified Organisms (GMO) foods; fish and seafood; restaurant and institutional food; beverages; sweeteners; cooking oil; and "other". The "other" category includes agro-food, grains (e.g., rice, corn, wheat), processed, engineered, and branded foods. Of these eleven types of food, the greatest proportion of articles addressed issues related to milk and dairy products. In turn, many of these articles focused on the 2008 melamine contaminated powdered milk and baby formula incident.

It appears from our analysis that two factors—seriousness of the incident and extent of media coverage—seem to be salient in accounting for which food safety incidents were addressed in the academic social science literature.

Seriousness and coverage, of course, are legitimate motivations to study an issue. If this is the predominant rationale for studying food safety incidents, however, there is a risk of the social sciences becoming a form of journalism or storytelling, with little or no capacity to develop theories with explanatory power. Developing and implementing a social science food safety research program would provide a less ephemeral foundation for studying food safety and, perhaps, more importantly, for effectively contributing knowledge towards addressing food safety issues.

In the context of emerging knowledge societies and economies, and, especially, the increasing call for evidence-informed policy-making, theory development may be important for the socio-cultural and political relevance of social sciences. This is because theoretical knowledge is seen as the most effective means by which academics can respond to the increasingly insistent calls to apply research knowledge to a range of policy and practical domains (Bell 1976).

Table 4 shows that about 46% of the articles reviewed identified an explicit food safety hazard in the abstracts, keywords, and/or article titles. We categorized these into two main types—intentional and unintentional—food safety hazards.

Table 4. Intentional and unintentional food safety hazards.

Types of Food Safety Hazards		#	%
Intentional food hazards		34	40
Illegal additives	Melamine and Clenbuterol	25	29.4
Counterfeit	Fake and adulterated food	5	5.9
Food crime	Fraud, food terrorism, bioterrorism, white-collar crime	4	4.7
Unintentional food hazards		51	60
Sub-standard quality	Sub-standard and or nutritionally imbalanced	20	23.5
Residues and contaminants	Fertilizer and pesticide residues, human and animal waste in water, and food poisoning caused by contaminated dumplings, beef, chicken and pork	20	23.5
Veterinary pharmaceuticals	Antibiotics, hormones	6	7.1
Infectious diseases	Food-borne infections, human and animal diseases such as avian flu (H7N9), bovine spongiform encephalopathy (BSE) (mad cow disease), variant Creutzfeldt-Jakob disease (vCJD), and other zoonoses	5	5.9
Total		**85**	**100**

Forty percent of the articles that identified food safety hazards (i.e., 85 of 185) focused onwe categorized as intentional food safety hazards. Intentional food safety hazards include a variety of

unethical and illegal acts generally motivated by the search for increased profits, but sometimes, as in the case of terrorist acts, motivated by political-cultural objectives and not financial gain. There are no studies of specific terrorist acts among the articles in our data set. Neither are there studies that focus on naturally occurring feed safety hazards. such as cyanogenic glycosides in cassava.

Where the quest for profit is the principle motive for intentionally contaminating and adulterating food, the tension between the public health and economic development dimensions of food safety is highlighted. Also highlighted is the policy maker's conundrum of how to find a balance between the two policy objectives. The salience of the public health dimension of food safety makes it all the more surprising that the articles reviewed did not address the public health dimensions of food safety.

Unintentional food safety risks were conceptualized as those that may result from the normal functioning of the food system. Such food safety incidents may not be the result of unethical or illegal behavior. Having said that, in some cases, these food risks and hazards may be the result of such behavior on the part of some food producers and processors. A case in point might be the overuse of antibiotics and growth hormones in livestock. On the other hand, this may be inadvertent or the result of inadequate information regarding appropriate use.

5.3. Structure and Content of Reviewed Literature

In this section we report information on the structure and content of the abstracts, key words, and article titles reviewed. This information is summarized below in Table 5. In terms of the food safety system categories, the greatest attention was paid to consumers, followed by legislators and regulators, primary producers, manufacturers, processors, transporters, media, researchers, educators, wholesalers, retailers, and, lastly, vendors and food service providers.

Table 5. Number of articles that mentioned one or more food safety system categories.

Food Safety System Categories *	1	2	3	>3	Total
Consumers	53	5	10	4	72
Legislators, regulators	30	3	14	5	52
Primary producers	13	3	13	6	35
Manufacturers, processors, and transporters	4	2	11	4	21
Media	5	1	9	5	20
Researchers, educators	4	3	5	3	15
Wholesale, retail	1	2	3	4	10
Vendors	3	1	1	2	7
Total	113	20	66	33	232

* Columns represent the number of food safety system categories identified in an article. Column 4 contains the number of articles with four or more categories in one article.

Regarding the distribution of articles across the food safety system categories, an almost equal number focused on single and multiple food safety system elements. Thus, it seems apparent that an implicit systems approach is being employed in about half of the articles. For social science research this is unsurprising—social sciences, after all, focus on patterned social interactions and relationships. What is surprising is that none of the abstracts explicitly stated that a systems model was used, even though, for example, relevant models are available (Garnett and Wilkes 2014; Munro et al. 2012).

Table 6 summarizes the dominant themes and the number and proportion of keywords associated with consumers, producers, manufacturers and processors, and legislators and regulators. It also identifies several themes associated with various types of media and the communication of information relevant to food safety issues.

Table 6. Selected themes by food safety system focus.

Focus	Themes	# of Keywords	% of Total
Consumers	Perceptions of quality, risk, safety, and trust	34	18.9
	Consumption intentions, decisions, and behaviours	30	16.2
	Purchasing intentions, behaviours, and willingness to pay	20	10.8
	Values, attitudes, and culture	17	9.2
	Total	**101**	**55.1**
Producers, manufacturing, processors	Structure/organization, scale	26	14.1
	International trade, countries, and regions	17	9.2
	Markets and marketing	12	6.5
	Performance and productivity	11	5.9
	Corporate social responsibility, corporate values	10	5.4
	Total	**76**	**41.1**
Government, legislators, regulators	Regulation and control	20	10.8
	Law, policy, and governance	16	8.6
	Standards and certification	8	4.3
	Total	**44**	**23.7**
Media—Information, education, communication	Labeling, information, and communication	21	11.4
	Social and news media	12	6.5
	Traceability	8	4.3
	Science, research, and education	5	2.7
	Total	**46**	**24.9**

The largest number of keywords related to consumers. Four major themes are associated with consumers: (1) Perceptions of quality, risk, safety, and trust; (2) consumption intentions, decisions, and behaviors; (3) purchasing intentions, behaviors, and willingness to pay; and (4) values, attitudes, and culture.

The four main themes identified through the keyword analysis are interrelated. Consumers' perceptions of safety, quality, risk, and trust in information and information sources are related to both purchase intentions and behaviors that themselves are influenced by culture, values, and attitudes.

We combined the categories "primary producers" and "manufacturers, processors, etc." into the category "primary and secondary producers". In examining the keywords and the results of the abstract analysis, it was clear that, despite differences and issues specific to primary and secondary producers, there also are many issues common to those involved in producing, marketing, and selling food. These common themes were dominant in the literature reviewed.

This is evident in the five main themes identified relative to primary and secondary food producers, namely: (1) Structure, organization, and scale [of production]; (2) international trade, countries, and regions; (3) markets and marketing; (4) performance and productivity; and (5) corporate values and corporate social responsibility.

The food producers and manufacturers theme with the greatest number of keywords is "structure, organization, and scale". It is largely, but not exclusively, focused on primary producers. Much of this research examines the relationships between the structure, organization, and scale of food production to both food safety and economic productivity. It is in the context of producers, both primary and secondary, of course, that economic development issues are most apparent and the contradictions between the public health and economic development imperatives are most obvious.

Although not represented in Table 6, we note that, relative to primary producers, environmental and sustainability issues emerged as a minor theme. We suspect that this relative lack of attention to these issues is an artifact of the knowledge classification systems used by Web of Science and Scopus. That is, we expect that research literature dealing with agricultural, environmental, and sustainability

issues may not be classified as social science. Similarly, none of the articles included in our research explicitly addressed food safety from public health dimensions of food safety. This may be because public health research is not classified as a social science by Web of Science or Scopus.

The dominant theme in the articles dealing with legislators and regulators is regulation. The second most common theme associated with this focus relates to a variety of food related legal, policy, and governance issues. The third focus is on standards and certification of food safety and quality.

Under the "media" element, in our food safety system model, we included a variety of references to information, education, and communication (IEC). The IEC themes are derived from the FAO food control system model.

Labeling and traceability are the most common issues discussed by article abstracts grouped under this category. These issues relate to developing and communicating information across the food safety system relevant to both domestic food purchase and consumption, as well as to importing and exporting food internationally. The twelve studies that address the issue of consumers' willingness to pay a premium for enhanced information about the safety and quality of food are grouped under consumer intentions and behaviors in Table 6.

The Media - IEC themes also include studies of social media as a means by which food safety information is disseminated to, and acquired by, consumers. Only one study addressed the role of state media as a source of information. In this domain, as well as in most others, the role and functions of social media will, undoubtedly, continue to grow in significance. Those engaged in public education will need to continue to develop expertise in the use of social media as a way to reach audiences. This includes, of course, developing critical assessment skills required to differentiate valid from invalid information and knowledge claims. Interestingly a very small number of the abstracts included in our study addressed the role and function of science as a source of relevant information.

Eight of the 185 article abstracts and keyword lists (less than 5%) identified a model or theoretical approach guiding the research, including risk theory, triple helix, game theory, ordered choice model, social theory, and the theory of planned behaviour

It could be the case that the use of analytical models and or theories are described in the full texts of the articles, however, this seems unlikely. It seemed clear from most of the abstracts reviewed that they were making empirical, not theoretical, contributions to the study of food safety in China. None of the abstracts or keyword lists made explicit reference to, or claimed to use, food system, food control system, or food safety system models.

A similar paucity of explicit identification of data, data collection, and analysis methods also characterizes the abstracts and keyword lists. Choice experiment, real choice experiment, and the Becker DeGroot Marschak (BDM) auction experiment method were the three data analysis methods that were mentioned.

A wider range of data analysis methods was presented. These included logit analysis, multivariate probit modeling, relational modeling, scientometric, and multiple-attribute modeling. With three mentions, structural equation modeling was the most frequently identified data analysis strategy.

Given the relatively small number of articles identified through our search strategy, the lack of consensus on the definition of food safety, as presented earlier, and the near absence of the use of analytical models or theories, it must be concluded that social science food safety research, in the Kuhnian sense, is pre-paradigmatic.

Food safety is a real and practical problem. We expected the research to have a strong applied character. To capture this we collected data on the presence of an explicit knowledge transfer strategy. None of the abstracts and keyword lists made any mention of an explicit strategy to facilitate the transfer and application of the research knowledge.

This is not to say that the authors of the abstracts did not include a variety of suggestions and recommendations for a variety of actors. In fact, most of the article abstracts made recommendations. Invariably, however, both the recommendations and the audiences to which they were directed were poorly defined. Also, because none of the abstracts identified an explicit knowledge transfer strategy,

there was no indication that the research was informed by, or conformed to, the general methodological principles known to characterize the effective transfer and use of research knowledge (El-Jardali and Fadlallah 2015; Graham and Dickinson 2007; Ivey et al. 2012; Murage et al. 2011; *Wikipedia*, s.v. Knowledge Transfer).

6. Conclusions

The main objective of this project was to use literature mapping methods to provide an outline of the form and a description of the substantive themes of the English-language, social sciences research literature on food safety in China published between 2009 and 2015 inclusive. The data used consisted of article abstracts, titles, and keywords that we analyzed using a combination of content analysis techniques. To frame the project, we presented a food safety system model that we used to categorize the research literature reviewed.

The published literature on literature mapping methodologies demonstrates the utility of the approach for identifying the evolving form and content of a wide variety of emerging and evolving research areas. In the context of the so-called information explosion, we feel that literature mapping methods combined with abstract and keyword analysis are useful tools for helping to describe the form and general focus of both emerging and evolving research areas.

In terms of the foci and themes of the research literature, we found that a food safety system model was very useful to categorize the existing research. Table 6, for example, categorizes both the foci of the literature reviewed based on our food safety systems model and the main substantive themes addressed within each of those categories. The themes were identified using content analysis methods. Mapping the literature using these methods provides insight into both what is included in the current research literature, as well as the gaps in coverage.

Several gaps in the current social sciences literature can be identified, including the relationships between food safety and environmental health and sustainability; and the public health dimensions of food safety control, including the processes by which technical exposure levels are set and enforced for domestic and international markets. It is also evident that evaluation research related to food safety systems is absent from the social sciences literature.

We are convinced that using abstracts as data for literature mapping has utility. Having said that, however, it must be noted that social science abstracts are inconsistent in terms of form, content, and quality. This issue is being addressed in the scientific literature, with the establishment of an international standard that specifies requirements for the form and content of scientific abstracts. We are not suggesting that the ISO 214:1976 can be simply transferred and applied to social sciences research, but it does suggest that standardizing social sciences abstracts, in terms of form and content, is an issue that could be, and should be, explored (International Organization for Standardization ISO). Addressing this issue would make an important contribution to making article abstracts more informative in general and useful to researchers using literature mapping and related methods in particular.

Keywords are an important and useful shorthand way to gain insight into the core content of articles. Like social science abstracts, however, they seem to be uneven in terms of criteria guiding keyword selection. For example, useful information could be provided on the theory or analytical framework used, data collection method (if appropriate), and data analysis technique (if appropriate), as well as core substantive foci.

Related and relevant articles may be missed because of a reliance on the knowledge categorization protocols used by aggregators, like Web of Science, Scopus, and others. For example, although our search and selection criteria resulted in a good sample of traditional social sciences articles, we did not capture evaluation, environmental, or public health literature that often is based on social science research methodologies.

Although this may be seen as a limitation of literature mapping methods, it can be converted into a strength in the sense that identification of these "gaps" in the social sciences literature will guide

researchers interested in these topics to search and review these complementary literatures by searching relevant databases and using appropriate search terms and selection criteria. Indeed, developing a comprehensive and integrated research program into food safety requires interdisciplinary research teams and inter-sectoral collaboration with industry, consumer, and public sector stakeholders.

Based on our study, we are persuaded that adopting an explicit systems approach to issues of food safety will help to bring cohesion and focus to an important area of research that is currently fragmented and unfocused. We recognize, of course, that the food safety system model we used as an organizing tool for this project is itself underdeveloped and in need of more precise specification. We also are of the opinion, however, that, as a heuristic device, such a model can help to give cohesion and focus to an import area of research and practice.

As we noted in the findings and discussion section, we were surprised that none of the literature reviewed identified an explicit knowledge transfer strategy. This, along with the fact that few of the articles identified an explicit theoretical approach from which hypotheses were derived and tested, may limit the potential of these important empirical research findings to inform and influence policy-makers and practitioners.

We suggest that social science researchers working on issues related to food safety consider employing explicit knowledge transfer strategies to increase the probability that their work gains the attention of those who are in positions to apply it.

Author Contributions: H.D.D. conceived of the project and was primarily responsible for developing the food safety system framework, data analysis and organizing and drafting the paper. W.L. was also involved in conceptualizing the project, and analyzing the data, copyediting and redrafting the paper. She also provided valuable insights into the socio-cultural and political context of food safety issues in contemporary China. P.J.G. is the librarian of our team and contributes an information and project management perspective. This includes providing support and recommendations on the search, retrieval and organization of information, as well as synthesis of content for the submission. He also took an active role in copy-editing the paper. W.C. is a doctoral candidate in Sociology at the University of Saskatchewan. Her contributions were in the areas of data management and analysis, copyediting and redrafting the paper.

Funding: This research received no external funding.

Acknowledgments: The authors would like to thank the anonymous reviewers for their constructive criticisms, insightful questions and helpful comments. They certainly helped improve the paper. We would also like to thank the journal's Editorial staff for their professional and prompt assistance and precise directions.

Conflicts of Interest: The authors declare no conflict of interest.

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