



Global Food Safety: A Primer

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Abstract Food is an essential human need that almost all governments have recognized as part of human rights. Food safety is the absence of physical, biological, and chemical hazards in food products. It is known to be an integral part of food security. Ensuring food safety to protect public health remains a significant challenge in both developing and developed countries. Increased attention has been given to the issue of food safety due to the globalization of the food supply chain, several large scandals, and unfair commercial practices. This paper presents an introduction on global food safety.

Keywords food safety, global food safety, international trade

Introduction

Food is an important for the livelihood of humans. It is the most fundamental consumer good in the world. Food has many facets, raising other issues such as security, quality, taste, culture, health, and economy. It is not just a basic necessity, it is an economic object. Food has emerged as an increasingly relevant issue in social and political arena. Food with balanced nutrients enhances human health.

In recent years, food safety has received increased global attention in public regulation and international food trade. The convergence of food safety standards at the international level has accelerated for the past two decades. Food safety plays a crucial role in maintaining people's well-being. Improving food safety is necessary to address food security. Nations will face serious barriers for food export if standards for food safety are not in place. Therefore, compliance with the food safety requirements of the global economy is a prerequisite for access.

Food Safety Concept

Food safety is the concept that food will not cause harm to the consumer. In other words, food safety ensures that food will not induce foodborne illness in the consumer. Food safety plays an important role in addressing food security and nutrition. It is also a fundamental component of public health. It is recognized as part of the effort toward reducing hunger [1].

Food safety is a complex concept. It may be regarded as an interdisciplinary scientific discipline describing processes for handling, storing, and preparing food that prevent foodborne illness. Major food safety concerns include foodborne diseases, contaminated food, residues and toxins, additives and preservatives, high sugar, and fat diets. Unsafe food contains hazards that can make people sick and causes both acute and chronic illness. Food hazards can lead to food losses and reduce food availability. Food safety controls are important in preventing, removing or destroying the pathogens in food. In spite of the efforts by government agencies and food companies to ensure food safety, some food products contain bacteria, parasites, fungi, and viruses.

Food safety is at the top of consumers' mind and consumer trust needs to be strengthened. Increased political and economic demands for more effective food safety controls have compelled nations to regulate food safety. It



has been shown that a scientific-based food safety system, such as Hazard Analysis and Critical Control Points (HACCP), helps reduce the likelihood of food safety incidents but it does not completely eliminate the possibility. HACCP is system developed by food-processing companies to assure safe food production and its scope of HACCP is comprehensive—from farm to fork [2].

Global Governance of Food Safety

Here we consider some intergovernmental organizations:

The World Health Organization (WHO)–www.who.int

The Global Food Safety Initiative (GFSI) - <https://mygfsi.com/>

The Food and Agriculture Organization (FAO) –www.fao.org

The World Trade Organization (WTO) - www.wto.org

The Codex Alimentarius Commission (CAC) –www.codexalimentarius.net

The World Organization for Animal Health (OIE)–www.oie.int

The role of each of these organizations fits into one of three categories: regulation of food standards, development of food standards, and implementation of food standards.

The Consumer Goods Forum established the Global Food Safety Initiative (GFSI) in 2000. GFSI was developed to standardize requirements, promote trade, and improve food safety. GFSI was formed after a number of food safety crises that led to consumer confidence to be an all-time low, several high-profile recalls, and negative publicity about the food industry. It is also a private governance system, outside both governmental regulations and international systems. It provides a platform for collaboration between food safety experts from all over the world including retailers, food service companies, service providers, international organizations, academia, and national governments in 21 countries, mainly in Western Europe, Australia, New Zealand, and North America. The development of GFSI recognized scheme is shown in Figure 1 [3].



Figure 1: The development of GFSI recognized scheme [3]

The GFSI is a non-profit making foundation whose mission is “safe food for consumers everywhere.” Its four objectives are [4]:

- Reduce food safety risks by delivering equivalence and convergence between effective food safety management systems
- Manage cost in the global food system by eliminating redundancy and improving operational efficiency through the harmonization of food safety regulations and standards worldwide
- Develop competencies and capacity building in food safety to create consistent and effective global food systems
- Provide an international platform for collaboration, knowledge exchange, and networking



As shown in Figure 2, the GFSI is governed by a Board that provides strategic direction and oversight. Three groups support the GFSI Board: an Advisory Council, a Stakeholder Group, and several Technical Working Groups [3].

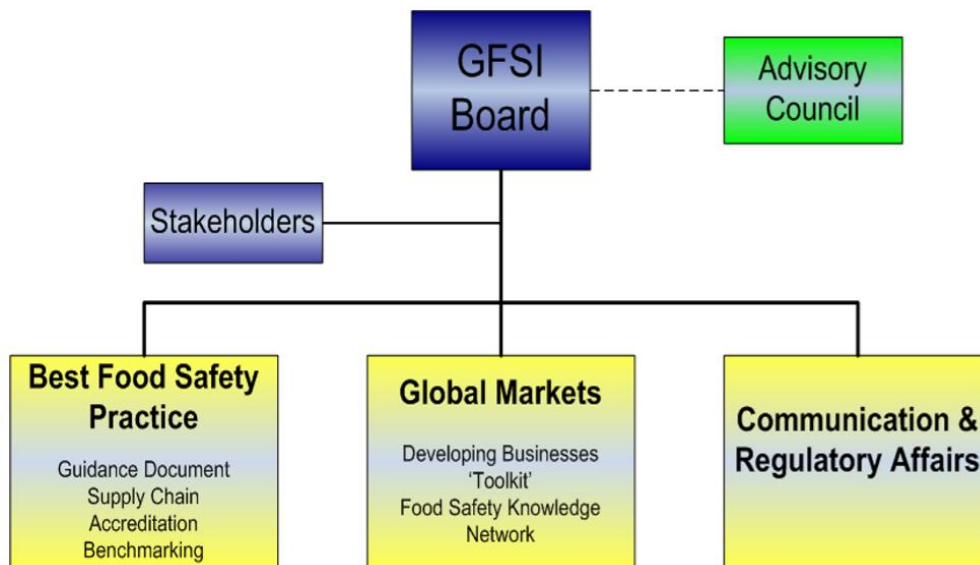


Figure 2: GFSI governance structure [3]

The World Health Organization (WHO) has been improving food safety since its inception. It recognizes food as a primary determinant of population health. The Codex Alimentarius Commission (CAC) is an intergovernmental body established in 1961 to protect the health of consumers and ensure fair practices globally. Its main strength is enabling a country to integrate international standards into their food safety systems. Codex standards are often stricter than US standards, for example. The World Trade Organization (WTO), established in 1995, relies on Codex standards as benchmarks in dispute resolutions between nations. The basic principles of the WTO are trade without discrimination and removal of trade barriers. The removal of trade barriers by WTO have given developing countries greater opportunities for economic growth and competitiveness. The Global Harmonization Initiative (GHI) is a global association of food scientists who develop global scientific consensus statements.

These organizations are driving changes to ensure the safety of food. Each national government can adopt these international standards for domestic compliance.

Global Megatrends and Food

Global trends such as climate change, aging population, increasing global population, urbanization, growing complexity of global food supply chains, and constantly changing patterns of human consumption pose significant challenges to global food safety [5].

- *Global Population:* The world population is expected to reach 9 billion by the year 2050. To produce more food and meet the necessary food demand may require large-scale farming, large-scale food processing and distribution. Rising global population and pollution are causing exposure to chemical hazards.
- *Climate Change:* This is a major global concern. Climate change may rise with globalization of the food supply. Local climatic conditions may affect local farming. Erratic climate changes can also affect the safety of the food supply and create new safety issues.
- *Globalized Supply:* Globalization is basically economic integration at the global level. As a result of globalization, all economies are interconnected. Globalization and free trade have opened up international borders. Globalization of the food supply chain has resulted in the ability of foodborne disease outbreaks to be transported and spread quickly. The globalization of news (through TV,



Internet, satellites, social media, etc.) has resulted in the ability for news to spread quickly and cause negative economic effects on the producers and significantly influence public perceptions of food safety. Global supermarkets, food service operators, and multinational food companies (such as McDonald's) are altering food safety rules.

- *Human Consumption:* Consumer acceptance is very important in the development of successful food products. Technologies are not equally accepted by consumers. Customer keep demanding for safer and higher quality products. Globalization has affected our social behavior, way of life, and consumer demand. There is a movement among consumers that promotes connectivity to the people, places, plants, and animals. They want everyone around the world to be able to access food that fulfills their cultural values.
- *Technology:* Current technological advancements, such as mobile technology, RFID, and 3D printing of food, may transform the food industry. Internet-based purchase of food will increase with increasing urbanization.
- *Deregulation:* This involves the dismantling government regulatory controls with the goal of opening up markets, reducing capital costs, and lowering consumer prices. The GFSI is a form of deregulation as it positions itself as an aid to government regulations. Deregulation manifests itself in GFSI in many ways such as through private standards superseding public standards and the involuntary implementation of these standards. Private standards such as the GFSI challenge the legitimacy of established international institutions, such as the World Trade Organization (WTO) and Codex Alimentarius Commission.

These factors lead to the need for continuous improvement and high skilled, knowledgeable employees to remain viable in a global environment.

Global Food Safety Problem

Recent years have witnessed a remarkable increase in cross-border trade in food. A nation may not be able develop a proper scientific justification as the basis to establish food safety regulations as mandated by WTO. There are different issues and priorities on food safety in developed nations versus developing nations. Food safety systems needs to accommodate the needs of developed and developing nations. National governments must ensure that all food products are safe for their citizens. Nations worldwide are facing difficulty in meeting international food safety and fair practices in the food trade. There is a need for nations to collaborate and address food safety problems from a global perspective.

- *United States:* In the United States, food production makes up ten percent of the United States global gross domestic product (GDP) and employs one in eight American workers. Like other developed nations, the US has its own set of food laws and regulations that account for their own perception of risk and resources. Food production and manufacturing facilities are audited by the US Food and Drug Administration (FDA), the United States Department of Agriculture (USDA), and inspectors from various local State Departments of Health. FDA is a regulatory agency within the US federal government. It has several international offices in Asia, Latin America, Europe, Africa, and Middle East, where FDA inspectors oversee food safety. The import share of the US domestic food consumption has gradually increased. American employers are now using job training and education to be able to cope with changes and challenges due to global industry trends. To stay competitive, companies must change continuously with constant probing of their environment [6,7]. International free trade agreements have reduced barriers that may prevent the US from expanding its markets.
- *United Kingdom:* Due to food safety incidents in the early 1990s, the UK experienced serious food safety confidence issues. Assured Food Standards was created to improve public confidence. The Red Tractor Assurance (RTA) scheme in UK sets out production standards developed by experts on safety. It ensures that certification occurs throughout the entire supply chain. Keys to the success of RTA include industry cooperation, traceability, and single national standard [8].
- *European Union:* The European Union (EU) is a supranational system of institutions supporting multiple initiatives. It represents a single market of about 500 million consumers across 27 member



states. It is less than half the size of India and a little more than one third of the size of China. The need to compete effectively with such global economies has been a major factor in the expansion of the EU over the last 50 years, from an initial Economic Community of just six Member States. Overall the EU is a net importer of food. In the 1950s and 1960s, EU started to develop European-wide food standards. There has been noticeable food safety regulations in Europe in recent years with maximum impact on consumer health and wellness. Food production in Europe relies on the European Union's General Food Law. The European Food Safety Authority (EFSA) provides independent scientific advice to European Member States. The Transatlantic Trade and Investment Partnership (TTIP) is expected to develop closer relationships between US and EU regulators. Both US and EU are big players in international agricultural trade. Codex standards are increasing becoming important to the EU [9].

- *Africa:* Access to safe food supplies is a pressing concern in Africa. Developing food safety standards still remains a challenge for many African nations. Also, compliance with food safety regulation is costly and enforcing compliance would make manufactured products expensive for average citizens. Some external donors such as Japan and EU assist in the implementation of the food safety in African countries. For example, the EU has been providing ongoing help in developing technical capacity in order to ensure that African food products meet EU import requirements. The International Food Safety Complex (IFSC) was developed to oversee the development and implementation of food safety standards and to ensure fairness. It has emerged as international institutional actors realized expertise gaps. Its key function is developing internationally recognized and consistent standards for production, processing, and storage of food. The main actors of IFSC include the WHO, the FAO, the Codex, the WTO, and the World Animal Health Organization (OIE). IFSC is influential in food safety regulation in Southern Africa. Ghana has adopted a lot of the international standards, guidelines, and best practices for different food products [10,11].
- *India:* India is a large country with each region having its own special products. Increased awareness of the customers has caused the government to put food safety at the heart of its concerns. India began to restructure its food safety policy in 2006. The Indian government relies on a strong regulatory body, the Food Safety Standards Authority of India (FSSAI), which is instrumental in carrying out risk analysis and enforcing regulations. Some food exports from India have been blacklisted by European and US food safety regulators. It is crucial that regulatory bodies, the food industry, and retailers work together to reverse the current trends in product export and protect consumer health [12].
- *China:* China is a large nation comprising various regions with different levels of economic development. Chinese culture is very rich and food-oriented. However, providing a reliable supply of safe, affordable food has been a major challenge. Food safety issue in China has been a major concern both for China and its international trading partners. The issue not only touches China's economic and political interests, but also the health of a vast number of consumers. China has experienced serious food safety accidents which affected the public health. However, in a developing country like China, food safety will remain a policy jurisdiction in which China has a long way to go. China Food Safety Initiative (CFSI) was meant to drive food safety forward collaboratively and mirror the priorities of GFSI for the region. The Initiative will improve consumer trust in the safety of food they consume daily. It has enjoyed strong support from the government, the private sector, and national agencies such as the China Food and Drug Administration (CFDA). China is increasingly becoming an important market for US food and agriculture products. China can learn from the experience of the world's advanced countries (such as US, UK, Japan, Canada) in food safety dispute settlement. In China, a significant part of the population purchase foods over the Internet [13,14].
- *Canada:* Canada has a more sophisticated food safety system and is regarded as a wealthy country. Canadian federal standards rely on established statutory law originating in Canada. In Canada, it is estimated that one third of the population is stricken with a foodborne disease each year. Much of the Canadian food legislation is based on the Codex Alimentarius. The GFSI has transferred control of Canadian food safety to a system outside of Canadian control [15].



- *Indonesia:* This is the fourth most populous country in the world with a population of 262 million. The Government of Indonesia recognized the right to adequate food through its 1945 Constitution of the Republic of Indonesia. The 2012 Food Law was initiated by the House of Representatives. The Law was essentially based on the principles of independence, equality, sustainability, food sovereignty, food self-sufficiency, food security, and food safety. It has been used for developing food regulations, including food safety. The most significant export destination nations for Indonesia are the US, Japan, China, Malaysia, and the EU [16].

Benefits and Challenges

Food safety is a real and practical problem. It closely linked with the problem of food control, as shown in Figure 3 [17]. Improving food safety is an important measure to achieve food security. The global food networks connect dispersed human populations bring new opportunities such as a greater variety of foods and economic growth. The importance of food safety to our health cannot be overstated. Common benefits of improved food safety include reduction in lost productivity and life without foodborne illness. Global food safety is an enabler of global food security. The international standardization and enforcement of food safety standards help global food trade, which promotes the global economy and improves people's standard of living.

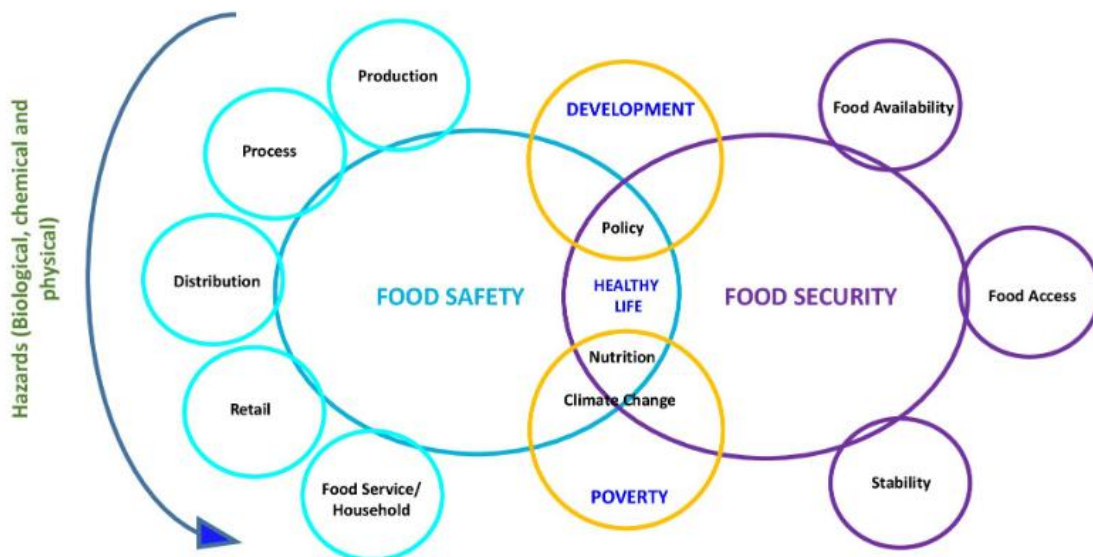


Figure 3: Relationship between food safety and food control [17]

In the past, domestic factors such as droughts, floods, earthquakes, and political instability often overshadowed food safety concerns. The increasing complexity of global food supply chains and the increasing imports from less developed countries pose some challenges to ensuring the safety of imported foods. Although traceability is an important factor in maintaining food safety, it can be a major challenge due to the highly complex global food product chains. Food safety is hard to regulate because it is hard to detect. Differences in food safety regulations can hinder the movement of food across national borders. Harmonization of regulations and standards are crucial for the global food safety. Some countries have inferior food safety standards. There is the need for international cooperation to achieve nano-safety, because nanoparticles are difficult to detect in imported goods,

Conclusion

Food safety has long been recognized as a serious, major global problem, which requires global solution. There is an increasing awareness of food safety within a sustainable global food supply. Today, food safety is being challenged by the global complex food supply chains and efficient use of natural resources. As food trade expands globally, food safety has become a shared concern among developed as well as developing countries. To address the emerging challenges faced by food safety system requires that food safety regulators around the



world to connect, collaborate, and come up with solutions. More information about global food safety can be found in the books in [18-22].

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References

- [1]. M. N. O. Sadiku, S.M. Musa, and O. S. Musa, "Food safety: A primer," *International Journal of Research Technology in Engineering & Management*, vol. 2, no. 6, June 2018, pp. 1-4.
- [2]. C. A. Weir, "Harmonizing international food safety: A case study of the Asia pacific region and the United States identifying mechanisms, constraints and resources," *Doctoral Dissertation, Michigan State University*, 2004.
- [3]. D. Garren, "Global Food Safety Initiative and Traceability," December 2009, https://www.fsis.usda.gov/wps/wcm/connect/d20dd79d-ab04-4444-95a2-ad6f2c48868/Trace_Garren_121009_958.pdf?MOD=AJPERES
- [4]. "Global Food Safety Initiative," Wikipedia, the free encyclopedia https://en.wikipedia.org/wiki/Global_Food_Safety_Initiative
- [5]. "Food safety for food security: Relationship between global megatrends and developments in food safety," *Trends in Food Science & Technology*, vol. 68, October 2017, pp. 160-175.
- [6]. C. K. Torwudzo, "Understanding the relationship between Global Food Safety Initiative (GFSI) and High Performance Work Systems (HPWS) and the role of employee learning and development," *Doctoral Dissertation, The George Washington University*, August 2014.
- [7]. M. C. Kuo, "Inspectors beyond borders: The extraterritorial governance of food safety in a global economy," *Doctoral Dissertation, University of California*, 2016.
- [8]. Connolly, L. S. Luo, and K. P. Connolly, "Global insights into essential elements food safety: The Chinese example," *Journal of Food Products Marketing*, vol. 22, no. 5, 2016, pp. 584-595.
- [9]. D. L. Post, "Food fights: Who shapes international food safety standards and who uses them?" *Doctoral Dissertation, University of California, Berkeley*, Spring 2005.
- [10]. C. Mukumba and D. J. Hornsby, "The International Food Safety Complex in Southern Africa: cooperation or competition?," *South African Journal of International Affairs*, vol. 18, no. 2, 2011, pp. 235-256.
- [11]. L. D. Mensah and D. Julien, "Enhancing access to the global food manufacturing value chain: The role of a food safety technical regulation in Ghana," *Journal of International Food & Agribusiness Marketing*, vol. 23, no. 3, 2011, pp. 247-270.
- [12]. N. Gautam, "Food safety: Global food safety concerns and Indian trade," July 2018, *Progressive Grocer India, Delhi* <https://search.proquest.com/docview/2078569041/fulltext/F4946EE62B384A7EPQ/1?accountid=7062>
- [13]. "The food industry in China steps up to food safety challenges with the Global Food Safety Initiative (GFSI)," *PR Newswire*, July 2016.
- [14]. Harley D. Dickinson et al., "Food safety in China: The structure and substantive foci of an emerging field of social science research," *Social Sciences*, vol. 7, 2018.



- [15]. E. A. Driscoll, "Neoliberal policy in action: a critical analysis of the global food safety initiative and food safety governance," Master's Thesis, University of Toronto, 2012.
- [16]. Nurliawati, "State's obligation for the human right to adequate (safe) food and global trade: A case study of Indonesian national-level inequalities in food safety standards for imported foods," Master's Thesis, Syracuse University, December 2018.
- [17]. M. Uyttendaele, E. Franz, and O. Schlüter, "Food safety, a global challenge," *International Journal of Environmental Research and Public Health*, vol. 13, 2016.
- [18]. C. A. Wallace. et al., *Food Safety For The 21st Century; Managing HACCP and Food Safety Throughout The Global Supply Chain*. Wiley-Blackwell, 2011.
- [19]. D. Bevilacqua, *Introduction to Global Food-Safety Law and Regulation*. Europa Law Publishing, 2015.
- [20]. C. E. Boisrobert et al., *Ensuring Global Food Safety: Exploring Global Harmonization*. Academic Press, 2010.
- [21]. M. Buckley and A. Reid (eds.), *Global Food Safety: Keeping Food Safe from Farm to Table*. Washington, DC: American Society for Microbiology, 2010.
- [22]. O. Dsouza (ed.), *Ensuring Global Food Safety: Exploring Global Harmonization*. Delve Publishing, 2019.

