



The impact of skills and education interventions on food safety outcomes

The impact of skills and education interventions on food safety outcomes

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RS Standards is at the forefront of chain standards development and improvement frameworks and is leading initiatives in sustainability, fisheries management, fishing and supply chain standards internationally with leading organisations.

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Executive summary

Each year, contaminated food causes over 600 million cases of preventable illness and 420,000 deaths worldwide. The impacts are disproportionately felt by individuals and governments in low- and middle-income countries (LMICs), which typically have a different food safety culture and lower standards of food safety education compared with upper-middle or higher income countries.

Raising awareness and skills in the safe handling of food is considered of critical importance in reducing the incidence of foodborne disease. Food safety education and training is one of three core areas of focus for Lloyd's Register Foundation, arising from its Foresight Review of Food Safety, published in 2019.

Whilst the report aims to maintain a global perspective on food safety programmes, the focus of key discussion points is on developing /economically transitioning countries, as this is where there is the greatest mismatch in need versus capacity. To help inform future action on this topic, through a desk-based review exercise and key-informant interviews, this report aims to provide insights into three areas of investigation.

1. What types of food safety and training programmes feature at a global level?

Several food safety programmes have been identified, with leading initiatives being run through organisations such as the FAO, WHO, the World Bank, International Union of Food Science and Technology (IUFoST), and the GFSI. The programmes of these international and regional networks are often linked with a food science R&D infrastructure provided by in-country universities and technology institutions. There may also be partnership building between countries, whereby a country will lend resource to build capacity in its partner; this is often linked to trade and market access. Additionally, private sector initiatives such as the GFSI Global Markets Programme and examples of public programmes (e.g. household food safety campaigns, school and university curricula and targeted interventions) have been identified.

The report categorises food safety training programmes into three main types: formal (e.g. professional qualifications and structured learning), non-formal (semi-structured learning) and informal (on the job, experience-based learning). Examples of food safety training programmes operating are: those running at a global and regional level, those tailored towards the specific business needs of the supply chain (e.g. GFSI programmes), and public funded training programmes that may be directed towards both the consumer and specific at-risk sectors.

In the context of harmonising global food safety education programmes, the IUFoST has taken a leading role, and has recently developed a list of core competencies for undergraduate food safety courses, and a Masters level programme in Food Safety Leadership. A few examples of food safety programmes targeted at school children (from early-years to 16-years) and households were identified for the USA and UK, which could provide some ideas for developing similar initiatives in LMICs.

2. To what extent do these programmes have a demonstrable impact on reducing foodborne illness and fatalities?

The monitoring and evaluation (M&E) of food safety training programmes is explored in Section 3.2. Only 11 peer-reviewed studies were found that measured the impact of training programmes in LMICs. These generally focused on the measurement of impacts of training, of specific training interventions for food handlers in schools and hospitals, and street vendors, doing a before-after comparison. Evidence from the peer-reviewed literature linking food safety training to reductions in food safety incidents is non-existent. This reflects more generally the lack of established food safety M&E frameworks globally.

Standard training plus behavioural interventions (e.g. incentive rewards, management support, and reminders) are the best way of improving handler performance. However, detailed evidence from the scientific literature is lacking with regards to understanding the factors that contribute to successful food safety outcomes.

There is also a lack of information on the costs-benefits of different types of training intervention, level of training (basic vs advanced), as well as other contextual factors that impact on training success such as the availability of tools and equipment, motivation, and cultural dimensions. It should also be noted that employee attitudes, beliefs, and motivation are more influential in shaping food safety behaviour than just knowledge alone. An emerging concept in recent years is food safety culture, used to explain people's attitudes and behaviours towards food safety, in particular what happens in an organisation when "nobody is looking".

A body of evidence that could further be explored is M&E data of internal training that may sit within businesses, and also that which may sit within certification / inspection bodies and third-party certification programme audit reports. With regards to the development of M&E programmes, sufficient thought needs to be spent on developing the M&E framework objectives and hypotheses for testing.

3. How can these programmes be applied in a variety of cultural / social contexts?

The key considerations for developing successful food safety programmes for different cultural / social contexts are outlined in Section 4. Incentives for enhancing food safety management capacity vary depending on where a country falls in the food safety life cycle. Many of the poorest countries are caught in a low-level capacity trap in which political and market incentives to build capacity are weak. It is not necessarily that food safety standards are lower in emerging countries, rather that it is difficult to achieve standards in these low resource areas due to the lack of education and food safety culture.

To have lasting impact on the food safety performance in domestic food safety systems in LMICs, broader development factors such as lack of infrastructure, poverty, and levels of literacy will need to be properly taken into account. This is to ensure food safety programmes are inclusive and not just serving the needs of higher-end markets. Other factors include the undertaking of baseline surveys to understand a country's specific food safety risks and needs, the importance of working with country institutions and building public-private sector partnerships

to expand the role of government beyond just control and enforcement, and considerations for M&E frameworks in LMICs where there may be a critical lack of resource and capability for collecting food safety data.

A food safety programme could involve both a combination of formal and informal training initiatives, organised into broad activity areas. For formal food safety education programmes, curricula can be tailored accordingly to the context of different countries and specific food safety challenges encountered.

Another key consideration is the impact of national cultures on the different methods of learning and training. Programmes should be tailored accordingly by working with educators who have a good understanding of local culture.

This review has provided some examples of different types of initiatives and information resources that could be adapted for different contexts or expanded. There are several organisations with an interest in developing food safety training and capacity building programmes, with often overlapping remits leading to inter-institutional politics and resource inefficiencies in funding and delivery of programmes. Collaboration with existing networks and partnerships between key institutions, allowing resources and information to be shared and allocated efficiently, will be key to maximising impact.

Emerging recommendations

The research informing this report indicates a clear need for a comprehensive framework for evaluating the effectiveness of food safety skills and education programmes that is easily understood, endorsed and accepted by a range of stakeholders. This need is both known to the sector and not easy to achieve: instead, metrics tend to be developed that are appropriate to the needs of specific initiatives or locations.

For a universal framework to be agreed, it is recommended that a series of steps be undertaken, led by Lloyd's Register Foundation and /or other relevant organisation(s). This would involve work with food sector businesses, including processors, retailers, certification bodies, regulators, auditors, academia, private and institutional food safety training service providers, and international organisations (such as the FAO, WHO, Codex) to:

- identify informal publications ('grey literature') arising from food safety evaluation programmes, which may reveal new insight into evaluation approaches and practice
- drawing on existing knowledge, to define, agree and endorse practical guidance for monitoring and evaluation of food safety training in different contexts and scales; and
- use this practical guidance to support a review of the effectiveness of food safety training.

1. Introduction

Lloyd's Register Foundation published its Foresight Review of Food Safety in 2019, the findings of which are based on research involving interviews with over 100 industry experts¹ from around the world. Three core areas were identified which the Foundation will now focus its future efforts and investment:

- food safety education and training
- traceability
- safety and sustainability in the seafood sector.

This is one of three reports related to these topics and focuses on where food safety training and education programmes feature at a global level, the extent to which these programmes have a demonstrable impact on reducing foodborne illness and fatalities, and how these programmes can be applied in a variety of cultural / social contexts.

The report was commissioned by the Foundation in 2020 and undertaken by RS Standards in late 2020-early 2021.

The evidence and insights presented in this review are derived from an information review comprising of a web-based search and peer-reviewed journal search, and key-informant interviews with food safety experts (see Section 2 for methods). Initial information was captured in a supplementary spreadsheet² and this informed the structure of this report.

This review has been written to help the reader focus from a general overview of the food safety training landscape to specifics, culminating in a list of recommended further work activities that have been derived from the expert interviews (Section 5) based on questions informed by the information review.



1.1 Project background

Each year, contaminated food causes over 600 million cases of preventable illness and 420,000 deaths worldwide. A World Bank study found that the impact of unsafe food costs low- and middle-income country (LMIC) economies about USD 110 billion in lost productivity and medical expenses each year³. The impacts are disproportionately felt by individuals and governments in LMICs.

1 Experts interviewed include food safety specialists from global food brands, academics from several leading universities, representatives from Lloyd's Register's specialist food assurance team and several NGOs

2 <https://www.lrfoundation.org.uk/en/news/skills-interventions-food-safety/> (link to spreadsheet at the bottom)

3 <https://www.worldbank.org/en/news/press-release/2018/10/23/food-borne-illnesses-cost-us-110-billion-per-year-in-low-and-middle-income-countries>

Despite similar, if not greater impacts than other diseases such as malaria or AIDs, there has been relative underinvestment in addressing food safety risks caused by biological, chemical and physical contamination (see Table 1). It is not necessarily that food safety standards are lower in LMICs; it is more difficult to achieve standards in these low resource areas due to the lack of education and food safety culture.

Table 1: Summary of the main food safety hazards

| Main categories of food safety contamination | |
|--|---|
| Biological | Bacterial – e.g. campylobacter, clostridium perfringens, E. coli, listeria, vibrio sp |
| | Viral – e.g. norovirus, hepatitis A |
| | Fungal – e.g. certain types of mould that produce mycotoxins such as aflatoxin |
| | Parasitic – e.g. helminths (worms), trichinella, toxoplasma and giardia |
| Chemical | Pesticides /herbicides /veterinary drugs – pose a risk if banned substances are used or not properly managed (e.g. antibiotics) |
| | Environmental contamination – e.g. contamination of water used in production |
| | Cross contamination during processing – allergen risks posed by poorly controlled production runs |
| Physical | Also known as ‘foreign body’ contamination, common sources can be debris from employees (e.g. hair, jewellery, finger nails), pests, dirt, glass, metal from unmaintained facility structures and machinery |

At a global level, the Foundation’s World Risk Poll⁴ found that 60% of the world’s population are worried about the food they eat, with 17% of poll respondents – equivalent to one billion people worldwide – experiencing serious harm, or know someone who experienced serious harm, caused by the food they ate. The poll indicates that the greatest levels of harm from food occur in East Africa (29% experienced harm) and the Middle East (27% experienced harm). Countries and territories that had experienced the most harm from food were those in the developing world; the top three countries were Liberia (52%), Zambia (51%) and Mozambique (45%).

The concept of the food safety life cycle (Annex 5 and Section 4.1) is a useful way of framing how food safety programmes evolve based on the economic development of a country. It shows that different types of food safety risks vary systematically with the level of economic development in a country, and the biggest gap between capacity and need is in countries transitioning from a least developed status to one exporting into global markets.

Food safety started becoming prominent on the agenda of developed countries in the 1980s; by the 1990s certified hazard analysis critical control point (HACCP) programmes were being offered with the goal of formalising food safety programmes. In the mid-1990s overseas aid started going towards developing countries to improve standards in export factories. Food safety certification schemes started emerging in the late 1990s (e.g. BRCGS, SQF, IFS, ISO 22000) with larger food businesses and exporting businesses now adopting these auditable standards. In 2000, the Global Foods Safety Initiative (GFSI) was launched helping to define the marketplace for food safety

4 The Lloyd’s Register Foundation World Risk Poll collected data on safety and risk from over 150,000 people in 142 countries <https://wrp.lrfoundation.org.uk/explore-the-poll/sixty-per-cent-of-people-worry-about-the-safety-of-their-food/>

certification schemes, with commercial training programmes soon following. Generally, in developed countries, the number of government run training programmes have reduced since 2010, with their focus more on providing guidance and E-learning resources for businesses.

The 2030 Agenda for Sustainable Development, adopted by all UN Member States in 2015, provides 17 Sustainable Development Goals (SDGs) of which the following are particularly relevant to efforts to improve food safety (from UN 2021⁵):

- **Goal 2 Zero Hunger** - There is no food security without food safety. Ending hunger is about all people having access to safe, nutritious and sufficient food all year round.
- **Goal 3 Good Health and Wellbeing** - Food safety has a direct impact on people's health and nutritional intake. Foodborne diseases are preventable.
- **Goal 12 Responsible Consumption and Production** - When countries strengthen their regulatory, scientific and technological capacities to ensure that food is safe and of the expected quality throughout the food chain, they move towards more sustainable patterns of food production and consumption.
- **Goal 17 Partnerships for the Goals** - A globalised world with annual food exports currently in excess of USD 1.6 trillion and complex food systems demands international cooperation across sectors to ensure food is safe. Food safety is a shared responsibility among governments, food industries, producers and consumers.



Focus of current food safety programmes run by the Foundation

The focus of the Foundation is very much on building capacity in LMICs. In partnership with the UN's Food and Agriculture Organization (FAO), the Foundation is currently running food safety programmes in East Africa and the Caribbean to build workforce capacity in these regions, and partner with local institutions to develop food safety curricula and build a trained workforce that can meet the needs of the particular country. For example, in East Africa the focus is on contamination of grains by aflatoxins produced by mould in cereal supply chains. In the Caribbean, food safety education initiatives are being targeted at the tourism industry to reduce food poisoning outbreaks in the food service sector and provide assurance in a sector that these countries' economies are highly dependent on.

Bio-security at the top of the global agenda

Bio-security is also at the forefront of the food safety agenda. At the time of writing this report the world is experiencing the COVID-19 pandemic, which is thought to have originated in food production systems in China⁶. This particularly emphasises the need for more robust food safety systems in areas where food production is being intensified though risks are not being appropriately managed.

5 <https://www.undp.org/sustainable-development-goals>

6 Report of the WHO-China Joint Mission on Coronavirus Disease 2019 (COVID-19) [https://www.who.int/publications/i/item/report-of-the-who-china-joint-mission-on-coronavirus-disease-2019-\(covid-19\)](https://www.who.int/publications/i/item/report-of-the-who-china-joint-mission-on-coronavirus-disease-2019-(covid-19))



The measures taken to slow the COVID-19 pandemic have tested the resilience of food supply chains that provide millions of jobs and provide safe, affordable and nutritious food for global society. COVID-19 has also exacerbated existing inequalities in the global food (and healthcare) system and the need to ensure that world's most vulnerable populations have access to safe and nutritious food.

1.2 Aims and objectives

Considering food safety in its entirety (microbiological, chemical, and physical contamination) this research looks to provide insights on the following questions:

1. What types of food safety and training programmes feature at a global level?
2. To what extent do these programmes have a demonstrable impact on reducing foodborne illness and fatalities?
3. How can these programmes be applied in a variety of cultural / social contexts?

Our approach to providing some answers to these questions is detailed in Section 2. Whilst we try to maintain a global perspective on food safety programmes, the focus of key discussion points is on LMICs, as this is where there is greatest mismatch in need versus capacity.

An information review was initially undertaken (Section 3) which informed a set of questions for interviews with key-informants to draw out key themes (Section 4).

A supplementary spreadsheet entitled 'Food Safety Programmes Information Matrix'⁷ provides additional information on some of the key programmes identified through this desk-based research.

⁷ <https://www.lrfoundation.org.uk/en/news/skills-interventions-food-safety/> (link to download spreadsheet at the bottom)

2. Methods and research approach

2.1 Desk based review

2.1.1 Information gathering

Internet searches

During December 2020 to January 2021 online research was undertaken to provide information about the types of food safety programmes featured at a global level.

Food safety education initiatives and programmes were identified through using Google search, using key search terms including:

Food safety education / food safety education initiatives / food safety assessment / food safety standards / food education / food safety training

The above search terms were combined with region i.e. by international level / by continent / group of countries / by country. Online searches yielded a large number of records for food safety education and providers. Standard information was gathered for each record / provider, where available (Table 2).

Table 2: Outline of information collected for each food safety programme

| | Information collected (where available online) |
|---------------------------------|---|
| Coverage | <ul style="list-style-type: none"> • Region / continent of operation • Country of operation • Type of organisation <ul style="list-style-type: none"> - Academic - Commercial - Government - Inter-governmental - Non-governmental organisation - Professional - Third party standards |
| About the organisation | <ul style="list-style-type: none"> • Name (including acronym) • Web address • Summary of the organisation • The funding • Links to other relevant organisations |
| Food safety education provision | <ul style="list-style-type: none"> • Summary of what they offer in food safety education • Type of food safety education provided <ul style="list-style-type: none"> - Formal - Non-formal - Informal • Who the intended target audience is for the food safety education <ul style="list-style-type: none"> - National - Academic - Commercial - Domestic / consumer |

Results were considered in detail to identify key information about the initiative or programme including the organisation involved. These are included in the supplementary Excel file entitled Food Safety Programmes Information Matrix⁸.

Scientific literature searches

A search was also undertaken in Web of Science⁹ in January 2021 using the following search terms:

“Food safety training OR food safety education”
AND “Monitoring OR evaluation”

The intention of this search was to get a quick overview of the key countries and institutions involved in monitoring and evaluation studies (see Section 3.2).

It was beyond the scope of this project to undertake a comprehensive literature review; the case-study examples shown in Section 3.2 are illustrative and chosen depending on how well they aligned with the research objectives and the Foundation’s regions of interest i.e. East Africa, Latin America, and SE Asia.

2.1.2 Framework for categorising programmes

The extent and type of education varies by country and by age demographic. To help investigate the types of food safety programmes this research used the categorisation of education into three main types, formal, non-formal and informal, developed by the Organisation for Economic Co-operation and Development (OECD)¹⁰. Table 3 provides definitions for each with associated types of education.

To understand the extent and types of training by different food safety programme, a broad perspective was taken. Food systems encompass the entire range of activities and actors in the production, processing, marketing, consumption, and disposal of food, including the inputs needed and outputs generated at each stage [1](see reference page 42).

For simplicity the food chain was separated into stages relating to the main type of activity. Then further sub-divided into sectors, which were related to the type of food safety education provision (Table 4, for further detail visit sheet 2 in the supplementary spreadsheet⁸, Food safety education food chain). Examples of training programmes for each key sector of the food chain are presented in Section 3.2.



8 <https://www.lrfoundation.org.uk/en/news/skills-interventions-food-safety/> (link to spreadsheet at the bottom)

9 A website with access to multiple databases that provide comprehensive citation data for many different academic disciplines

10 OECD (2010), Recognising Non-Formal and Informal Learning: Outcomes, Policies and Practices

Table 3: OECD definitions of education and examples for each type

| Education category | Definition | Examples of types /sources of education provided |
|----------------------|--|--|
| Formal education | Formal learning is always organised and structured, with learning objectives. From the learner's standpoint, it is always intentional: i.e. the learner's explicit objective is to gain knowledge, skills and / or competences. | <ul style="list-style-type: none"> • Primary and secondary education • Apprenticeships • Further and higher education • Training courses • Professional development |
| Non-formal education | Non-formal learning is organised and can have learning objectives. It exists between formal and informal education as the learning may occur at the initiative of the individual however it also happens as a by-product of more organised activities, whether the activities themselves have learning objectives. | <ul style="list-style-type: none"> • Youth organisations (e.g. scouts, guides) • Adult education provided outside formal education (e.g. evening or online classes to learn key skills) |
| Informal education | Informal learning is never organised, has no set objective in terms of learning outcomes and is never intentional from the learner's standpoint. Often it is referred to as learning by experience or just as experience. | <ul style="list-style-type: none"> • Family • Peers (social groups) • Colleagues (work environment) |

Table 4: Key stages of the food supply chain and supporting institutions. In its entirety this forms a food system

| | Stage of the food chain | Sector |
|---|--------------------------------------|--------------------------------------|
| Food chain | Primary production (commercial) | Agriculture |
| | | Fishing |
| | | Aquaculture |
| | Processing and handling (commercial) | Feed production |
| | | Processing (primary, secondary) |
| | | Transport and distribution |
| | Tertiary (consumption by consumers) | Commercial foodservice |
| | | Domestic foodservice and preparation |
| | | Commercial retail |
| Other essential support functions to the food chain | Government policy and enforcement | Policy / regulation |
| | | Enforcement |
| | Science and research | Academic |
| | | Commercial providers |
| | Service providers | Food testing |
| | | Auditing (external) |

2.2 Key informant interviews

2.2.1 Questions

The desk research was used to inform the initial questions developed for the interviews as shown in Annex 1. A semi-structured interview technique was undertaken, with discussion allowed to flow into areas of interest outside the original questions and provide rich qualitative data that has been used to identify key themes for the discussion. Informal notes were taken at each interview rather than verbatim speech, due to time considerations. All interviewees were informed that their responses would be treated anonymously.

2.2.2 Approach

In consultation with the Foundation a shortlist of provisional food safety experts to engage with was drafted. These stakeholders were chosen on the basis of being highly regarded in their respective sectors.

The sampling strategy evolved into 'snowballing' whereby several interviewees provided us with contacts to follow-up. In total, we sent emails to 11 people to see if they would be interested in being interviewed for the research, and between December 2020 – March 2021 we interviewed nine. We obtained input from different sectors including universities, international development experts, training providers, and public authorities. A summary of the key sectors and organisations we interviewed are shown in Annex 2.

3. Information review

The findings in this section come from the desk-based review and have been validated through some of the expert interviews.

3.1 The food safety training landscape

SUMMARY

- This report identifies several food safety programmes, with leading initiatives being run through organisations such as the FAO, WHO, World Bank, IUFOST, and the GFSI.
- The programmes of these international and regional networks are often linked with a food science R&D infrastructure provided by in-country university and technology institutions.
- There may also be partnership building between countries, whereby a country will lend resource to build capacity in its partner. This is often linked to trade and market access.
- The GFSI Global Markets Programme is a leading private sector initiative to help small or less developed companies to achieve certification to GFSI recognised food safety schemes and market access.
- An emerging concept in recent years is ‘food safety culture’ (FSC) that is used to explain people’s attitudes and behaviours towards food safety, in particular what happens in an organisation when “nobody is looking”. FSC is becoming an increasing area of focus by third-party certification schemes.

3.1.1 Programmes at a global and regional level

The relevant UN SDGs pertaining to food safety and security are goals 2, 3, 12, and 17 (see page 6) and provide the umbrella under which international and regional activities are occurring. At a global level, the Codex Alimentarius Commission (CAC)¹¹ established in 1961, by the FAO and WHO, provides the global benchmark for food safety standards that countries are encouraged to adopt in their national regulations. There are 189 countries (out of 195) that are members of the CAC and to facilitate full member participation in their work programmes the CAC provides an E-learning platform.

The FAO and WHO have capacity building programmes at a regional scale, with staff collaborating with regional food safety networks (see Annex 3 for examples). The programmes of these international and regional networks are often linked with a food science R&D infrastructure provided by in-country university and technology institutions. There may also be partnership building between countries, whereby a country will lend resource to build capacity in its partner, this is often linked to trade and market access (for example, see the EU accession programme¹²).

11 <http://www.fao.org/fao-who-codexalimentarius/home/it/>

12 https://ec.europa.eu/neighbourhood-enlargement/instruments/overview_en

The supplementary Food Safety Programmes Information Matrix¹³ provides an overview of the various types of food safety programme operating globally, the target audiences of these programmes can be summarised as falling into four broad categories; government policy / regulatory, academic, business (supply chain i.e. producers, food handlers, processors, food service etc.), and consumers. A summary of the key global initiatives is shown in Table 5 on the next page. (An expanded version of this table is found on sheet 3 of the supplementary spreadsheet¹³.) The following initiatives are worthy of specific attention:

- International Union of Food Science and Technology (IUFoST) – commissioned to lead an initiative to identify gaps in food safety curricula and to establish and harmonise core competencies at the undergraduate and graduate levels (see Section 4.2).
- Global Food Safety Initiative (GFSI) – its Global Markets Programme provides a stepwise pathway towards GFSI-recognised certification for companies that lack or wish to improve their food safety systems (see Section 3.1.2 for further detail).
- World Bank programmes and publications – the ‘The Safe Food Imperative’ [1] (see reference 1 on page 42) should be an essential read for anybody involved in capacity building projects.
- World Food Safety Day¹⁴ established by the WHO in 2019 with the aim to raise the profile of food safety on the public agenda.
- Bio-security emerging area of focus – see FAO-EMPRES¹⁵, World Bank Food Systems 2030 fund¹⁶ (taking on the work established by the Global Food Safety Partnership that closed in December 2020).



13 <https://www.lrfoundation.org.uk/en/news/skills-interventions-food-safety/> (link to download spreadsheet at the bottom)

14 <https://www.un.org/en/observances/food-safety-day>

15 <http://www.fao.org/ag/againfo/programmes/en/empres/home.asp>

16 <https://www.worldbank.org/en/topic/agriculture/brief/food-systems-2030>

Table 5: A summary of some of the key global food safety organisations and initiatives

| Organisation /initiative and description of food safety education programmes | Delivery | | | Intended target audience | | | |
|--|----------|------------|----------|--------------------------|----------|----------|----------|
| | Formal | Non-formal | Informal | Policy | Academic | Business | Consumer |
| <p>Food and Agriculture Organization (FAO) of the United Nations</p> <p>FAO provides reports, guidance and policy aimed at countries to use in their own systems. It also provides an E-learning portal for people to use free of charge, including a wide range of subjects on food security, safety etc.</p> | ✓ | | ✓ | ✓ | | ✓ | |
| <p>World Health Organization (WHO) and regional programmes</p> <p>WHO provides reports and resources on a wide range of food safety topics, at arm's length from direct education initiatives. However, it develops underlying principles and agreed procedures to managing risk. It also provides platforms for food safety data sharing e.g. contaminants. WHO food safety guidelines are built on five principles: keeping clean; separating fresh from cooked food; full cooking; storing food at safe temperature; and consume healthy drinking water and raw materials.</p> | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| <p>Codex Alimentarius Commission (CAC)</p> <p>Codex has online learning to explain the organisation, management and procedures of the CAC and its subsidiary bodies. The scientific basis for Codex standards provided by the FAO / WHO programme on the provision of scientific advice is described. The course also provides guidance on developing national Codex structures and activities to enhance effectiveness of all Codex members.</p> | | ✓ | | ✓ | | ✓ | |
| <p>International Food Policy Research Institute (IFPRI)</p> <p>Provides detailed information online, publications, and signposts to other information.</p> | | ✓ | ✓ | | ✓ | | |
| <p>Global Food Safety Partnership (GFSP)*</p> <p>The work of GFSP is focused on LMICs. Its approach includes disseminating lessons learned and best practices to inform future food safety capacity building. It also funds specific programmes of work including one on Global Food Safety Curriculum Development.</p> <p>*GFSP closed in December 2020. Its work is now being addressed fully within the Agriculture and Food Global Practice of the World Bank, under the Food Systems 2030 umbrella trust fund.</p> | | | ✓ | ✓ | ✓ | ✓ | |

Table 5 contd: A summary of some of the key global food safety organisations and initiatives

| Organisation /initiative and description of food safety education programmes | Delivery | | | Intended target audience | | | |
|--|----------|------------|----------|--------------------------|----------|----------|----------|
| | Formal | Non-formal | Informal | Policy | Academic | Business | Consumer |
| <p>International Union of Food Science and Technology (IUFOST)</p> <p>IUFOST has been requested by the Global Food Safety Partnership of the World Bank Secretariat to lead undergraduate and graduate food safety curricula global standardisation.</p> | ✓ | ✓ | ✓ | | ✓ | ✓ | |
| <p>Joint Institute for Food Safety and Applied Nutrition (JIFSAN)</p> <p>JIFSAN works directly with various US government agencies, including FDA, USDA, EPA and others, with input from industry, consumer groups and foreign government agencies to develop and deliver science-based food safety training. Programmes are directed to the point of production and to all steps in handling, processing and distribution.</p> | ✓ | ✓ | | | ✓ | ✓ | |
| <p>Institute for Food Technologists (IFT)</p> <p>A professional membership organisation, since 1939 it has been a forum for food professionals and technologists to collaborate, learn, and contribute, all with the goal of inspiring and transforming collective scientific knowledge into innovative solutions for the global food chain. Over 15,000 members across over 90 countries.</p> | ✓ | ✓ | ✓ | | ✓ | ✓ | |
| <p>International HACCP Alliance</p> <p>The Alliance was developed in 1994, to provide a uniform programme to assure safer meat and poultry products. It provides information guides, training on HACCP and updates on food safety issues. It reviews other people's HACCP courses to determine if there is equivalency.</p> | ✓ | ✓ | ✓ | | | ✓ | |
| <p>Global Food Safety Initiative (GFSI)</p> <p>Created in 2000 as an initiative of the Consumer Goods Forum (CGF), the aim is to build consumers trust in the food they buy, by improving food safety management practices. The Global Markets Programme is a pathway towards GFSI recognised certification. For companies that are looking to improve their food safety systems. It provides open access toolkits that guide companies through pre-certification stages.</p> | | | ✓ | | | ✓ | |

Table 5 contd: A summary of some of the key global food safety organisations and initiatives

| Organisation /initiative and description of food safety education programmes | Delivery | | | Intended target audience | | | |
|---|----------|------------|----------|--------------------------|----------|----------|----------|
| | Formal | Non-formal | Informal | Policy | Academic | Business | Consumer |
| <p>International Association for Food Protection (IAFP)</p> <p>Members from over 50 countries, covering the broad range of disciplines involved in food industry and production. Focused on professional development of its members, it provides a range of webinars, conferences.</p> | | ✓ | ✓ | | ✓ | ✓ | |
| <p>Consultative Group on International Agricultural Research (CGIAR)</p> <p>CGIAR is a global agricultural innovation network. Provides evidence to policy makers, innovation to partners, and new tools to harness the economic, environmental and nutritional power of agriculture. It includes a network of 15 research facilities covering different parts of the food supply chain, primarily focused on agriculture. Part of the remit is to improve food production, food safety.</p> | | ✓ | ✓ | ✓ | | ✓ | |
| <p>International Food Policy Research Institute (IFPRI)</p> <p>IFPRI currently has more than 600 employees working in over 50 countries. It is a research centre of CGIAR, a worldwide partnership engaged in agricultural research for development. It provides detailed information online, publications, signpost to other information.</p> | | ✓ | ✓ | | ✓ | | |
| <p>Global Food Safety Advisory Program (GFSAP)</p> <p>Run by the IFC, the largest global development institution focused on the private sector in developing countries. IFC's support includes food safety assessments, staff training, and guidance attaining international certification. It provides online training (basic).</p> | | ✓ | ✓ | | | ✓ | |
| <p>SSAFE Food</p> <p>Undertakes a number of projects in target areas to develop resources and approaches to tackle food safety. For example, food safety training in China, production of a free food fraud vulnerability assessment tool etc.</p> | ✓ | ✓ | ✓ | | | ✓ | |
| <p>World Food Safety Organisation (WFSO)</p> <p>Offers certification for individuals, business and operations along with training and consulting on food safety management systems. It provides a number of online training courses.</p> | ✓ | | ✓ | | | ✓ | |



3.1.2 Supply chain and businesses

The fundamental tool at a business level for managing food safety risks are standards, with B2B certification providing assurance to customers further downstream in the supply chain that food safety risks are being managed properly. This can range from HACCP¹⁷ certification through to GFSI recognised third-party certification schemes¹⁸. In developing countries, trade agreements with developed countries are often conditional on producers, processors, and traders in exporting supply chains being audited against and certified to rigorous third-party standards.

Private training for businesses

Since the arrival of these certification schemes on the market, there has been a plethora of training providers and consultancy firms that provide training on food safety basics, focused on specific areas (e.g. HACCP, food labelling legislation) and comprehensive training to enable businesses to understand the requirements and business practicalities of certification¹⁹. The quality of course can vary significantly and it is particularly important that providers who claim to provide training certificates are accredited or recognised by a reputable body.

Since COVID-19 there has also been an acceleration towards remote learning. Whilst sufficient bandwidth may be a problem in more remote regions, many training providers are seeing a shift towards this type of delivery as it is more cost effective. Enabling technologies like real-time translation, effective use of video technology coupled with on the ground facilitation allows sessions to still have a good level of interactivity. However, the success of delivering remote training is very much dependent on the leadership and attitudes of facility managers.

For small- and medium-sized enterprises (SMEs), that may have less incentive to be third-party certified, online E-learning platforms and mobile apps have been used to deliver basic entry level food safety training, particularly in remote regions where the logistical costs of delivering face-to-face training are impractical. Monitoring the uptake and success of these types of programme remain challenging. Given the fewer market incentives for SMEs to engage in food safety programmes, this is often an area of focus for government intervention (see Section 3.1.3).

17 For example, <https://www.sgs.co.uk/en-gb/agriculture-food/commodities/audit-certification-and-verification/certification/haccp-certification>

18 <https://mygfsi.com/how-to-implement/recognition/>

19 For example, <https://www.integritycompliance.com.au/pages/home>, Safe Food Training Hub <https://safefoodtraininghub.globalfoodsafetyresource.com/>, <https://globalfoodsafetyresource.com/>

The GFSI Global Markets Programme

The GFSI Global Markets Programme (GMP) launched in 2008 to help small or less developed companies to achieve certification to GFSI recognised food safety schemes and market access. The GFSI is not a training organisation, however its GMP provides a framework (and checklists) for continuous improvement, based primarily on the Codex General Principles of Food Hygiene Code of Practice. The GMP provides guidance on the development and delivery of training, and the competencies required to achieve the GMP basic and intermediate levels for food manufacturing.

The GFSI have developed a guidance document²⁰ for the main groups of stakeholders, with the intention that:

- companies choosing a training provider are encouraged to specify that any training plans meet the criteria defined in the GMP guidance document
- training providers should use the guidance to develop their training programmes; and
- individual learners should use the document to help them develop their own training plan.

Food safety culture

Conducting audits and inspections is not a foolproof means of guaranteeing food safety within a supply chain. Whilst certification schemes have been a useful way of monitoring procedural compliance, the food industry still suffers from incidents such as product recalls, food poisoning outbreaks and allergen contamination.

A key concept emerging since 2009 has been around developing a ‘food safety culture’ (FSC) (Figure 1) to explain differences in food safety performance across organisations, and the variability in the effectiveness of training programmes. Levels of training and food safety knowledge are often poor predictors of safe food handling, and the concept of FSC is used to explain people’s attitudes and behaviours towards food safety, in particular what happens in an organisation when “nobody is looking” [1]. FSC encompasses informal learning within an organisation, and the beliefs, behaviours, and assumptions that are learned or shared, permeating down from an organisation’s mission and values.

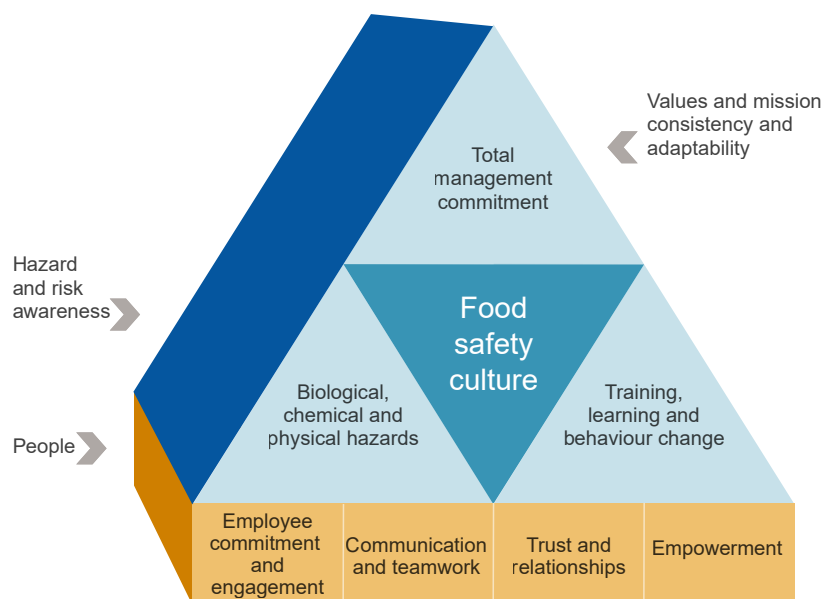


Figure 1: Dimensions of a food safety culture (Source: DNV Food Safety Culture Program)

²⁰ <https://mygfsi.com/wp-content/uploads/2019/09/GFSI-Global-Markets-Manufacturing-Training-V2.pdf>

All major retailer and GFSI standards now require the development and implementation of a FSC programme. The GFSI Food Safety Culture Position Paper²¹ states that “to be successful and sustainable, food safety must go beyond formal regulations to live within the culture of a company.” In contrast with solely being based on adherence to regulation, FSC is a measure of the attitudes, beliefs and behaviours in an organisation. GFSI have started to define the level of FSC maturity within an organisation over five phases (see Table 6 for summary of the GFSI Education and Training Maturity Model).

3.1.3 Public (and non-profit) programmes

Public sector food safety training activities are typically focused in the following areas:

- household food safety campaigns
- targeted interventions in ‘at risk’ sectors
- school curriculum; and
- university and college courses.

Household food safety campaigns

The FAO states that poor hygiene practices in the home are responsible for between 30-40% of foodborne illness²² and has assisted in the design of public information /education programmes and consumer messaging. On the latter, the WHO has developed the Five Keys to Safer Food Programme²³ which has been successfully running for two decades. Fundamentally this programme covers the following food safety messages:

1. keep clean
2. separate raw and cooked
3. cook thoroughly
4. keep food at safe temperature; and
5. use safe water and raw materials.

The WHO messaging is essentially embedded in the campaigns of various national food safety agencies. For example, the Food Standards Scotland campaign on food safety practices in the home, and raising awareness of how changes to preparation and cooking behaviour can reduce the likelihood of getting food poisoning²⁴.



21 <https://mygfsi.com/wp-content/uploads/2019/09/GFSI-Food-Safety-Culture-Full.pdf>

22 Based on several national and international reports <http://www.fao.org/food/food-safety-quality/capacity-development/public-education-communication/en/>

23 See <https://www.who.int/publications/i/item/five-keys-to-safer-food-manual> for details

24 Food Safety Campaign Toolkit | Food Standards Scotland <https://www.foodstandards.gov.scot/consumers/food-safety/at-home/kitchen-crimes/food-safety-campaign-toolkit>

Table 6: Outline of the GFSI FSC education and training maturity model to foster culture change from both top-down and bottom-up²⁵

| | Frontline employees | | Middle management | | Senior management | | |
|-----------------------|------------------------|--|---|---|--|---|--|
| | Suggestions to improve | Maturity characteristics | Suggestions to improve | Maturity characteristics | Suggestions to improve | Maturity characteristics | |
| Maturity model phases | 1 | Update training content to reflect current operational, regulatory, customer expectations AND to keep employees engaged. | Either no training or compliance training only; limited onboarding training. | Customised induction training developed for supervisors. | No recognition from supervisors that training for this population is necessary. | Development of customised induction training for senior management. | No recognition from executives that training for this population is necessary. Food safety seen as quality assurance issue only. |
| | 2 | Training materials should go beyond rules, with focus on the risks concepts and their consequences. | Company continues to be reactive to food safety issues. | Systems developed to provide training, to manage information and to record performance. | Company remains in reactive mode regarding food safety issues, no consideration given other than responding to complaints, recalls or poor inspection results. | Begin development of systems to provide training, manage information and record performance. | Company operates in reactive mode regarding food safety issues, no action other than in response to complaints, recalls or poor inspection results. |
| | 3 | Specific training developed and delivered for every area across the company; some evaluation of understanding and confidence in understanding being implemented. | Employees understand rules are mandatory but they do not always follow the rules. | Further implementation of systems, development of area-specific training and evaluation of knowledge, comprehension and confidence. | Company remains in reactive mode, but has started a formal system for staff training and development; system remains general with no food safety roles or responsibilities specified. | Further implementation of systems, development of area-specific training and evaluation of knowledge and understanding (and confidence). | Beginning of systems development to provide training, manage information and record performance. |
| | 4 | Strong system in place to evaluate understanding and confidence, support mechanisms in place for staff who show poor understanding or lack confidence. | Majority of staff, understand what the control mechanisms are and how to implement them, they have confidence to act if they see something they know to be wrong. | Ongoing coaching and support for supervisory team as they develop much stronger understanding of food safety risks. | Proactive food safety messages incorporated into regular senior management communications and shared. | Senior management coached and supported as leaders develop a stronger understanding of food safety risks. | Proactive food safety messages incorporated into regular communications from senior management; formal system of management training in place and implemented. |
| | 5 | Continuous improvement. Encourage confident employees to monitor and observe each other and provide feedback and coaching around food safety. | Formal system for training exists as induction and refresher trainings and its contents is reviewed periodically to go deeper. | Continuous improvement of technical and behavioural skills. | Food safety training integral to supervisory roles, tailored to specific areas but all supervisors able to explain key risk areas, controls and why food safety culture across the organisation is important and their respective roles. | Food safety messaging updated frequently to keep information fresh. Senior management actively supports suppliers' improvements in food safety initiatives. | Food safety training integral to senior management roles, tailored to specific areas but all executives can explain key risk areas, controls and why food safety culture is essential across the organisation. |

²⁵ GFSI 2019 <https://mygfsi.com/wp-content/uploads/2019/09/GFSI-Global-Markets-Manufacturing-Training-V2.pdf>

Targeted interventions in 'at risk' sectors

Public sector authorities may directly intervene in targeted interventions for sectors deemed a high food safety risk. This may involve raising standards in production where there are known specific risks (e.g. microbial contamination in the poultry industry), or targeted training for SMEs and food service outlets who may not have staff with professional backgrounds in food safety, and where there is a particular risk of businesses failing to meet basic food safety legislation requirements. This could involve public bodies developing 'train the trainer' type programmes, with the aim to quickly build capacity through establishing a network of training providers, and subsidising costs for businesses to attend these sessions. The Sea Fish Industry Authority in the UK uses this approach, targeting SMEs, and has established a training academy that provides basic food safety E-learning materials as well as more advanced course offerings and details on recognised training providers²⁶.

School curriculum

Food hygiene and healthy eating fundamentals are taught as early from 3-years in the USA and UK, and the curriculum is progressed through school years. It is likely that this will be similar for other high-income countries as well, though this would need to be verified.

In the UK, the Food a Fact of Life (FFL) initiative²⁷ is a comprehensive, progressive education programme which communicates up-to-date, evidence-based, consistent and accurate messages around 'food' to all of those involved in education. It is compliant with the UK school curriculum. The FFL website provides a range of learning and teaching resources for children 3-16 years old, it also provides professional development materials for teachers. It is overseen by four education working groups who review work and help set future development.

Similar to the UK, the USA Partnership for Food Safety Education (PFSE) FightBAC initiative²⁸ works with a network of 13,000 health and food safety educators. Whilst it covers school teaching materials, the PFSE has a border public health remit and works with consumers²⁹ and businesses. As with the FFL, food safety messages are rooted in science, and they work with scientific and communications experts to develop concise, actionable food safety education materials for consumers. They also host a number of webinars.



26 <https://seafoodacademy.org/>

27 <https://www.foodafactoflife.org.uk/>

28 The FightBAC campaign uses the "core four" food safety messages of clean, separate, cook, and chill
<https://www.fightbac.org/>

29 For example, it holds a Consumer Food Safety Education Conference.

University and college course curriculum

IUFoST with the Global Food Safety Partnership (now disbanded) launched the Global Food Safety Curricula Initiative (GFSCI)³⁰ in 2013 with the intention to identify gaps in food safety curricula and to establish and harmonise core competencies at the undergraduate and graduate levels in order to improve food safety and security worldwide. The GFSCI has engaged with over 30 countries and involved cross-sectoral collaboration with government, industry and academia.

The GFSCI outputs have been a global Food Safety Graduate Database; development of a new International Leadership Masters Curricula tailored at country and regional levels; and undergraduate curricula Core Competencies (see Annex 4 for further details).

IUFoST will play an ongoing role in accrediting university courses that have used the GFSCI international standard as their foundation.

3.2 The monitoring and evaluation of food safety programmes

SUMMARY

- A review of the peer-reviewed literature found that only 11 studies measured the impact of training programmes in LMICs.
- Evidence from the peer-reviewed literature linking food safety training to reductions in food safety incidents is non-existent. It is also methodologically challenging to measure, due to the scale at which food safety incidents are often recorded (i.e. at a national level, annually) compared with interventions which are typically implemented and measured at business level.
- Impacts at the business level show training that just relies on the presentation of science-based facts and assessment can also ignore the organisational food safety culture and context. Employee attitudes, beliefs, and motivation are more influential in shaping food safety behaviour than just knowledge alone.
- Standard training plus behavioural interventions (e.g. incentive rewards, management support, and reminders) are the best way of improving food handler performance, however, detailed evidence from the scientific literature is lacking with regards to understanding the factors that contribute to successful food safety outcomes.
- With regards to the development of monitoring and evaluation (M&E) programmes, sufficient thought needs to be spent on developing the M&E framework objectives and hypotheses for testing.

A provisional search³¹ of “food safety training OR food safety education” in the scientific literature returned 3,530 publications, when the search was narrowed to also include “monitoring OR evaluation” 647 publications were returned. Publications from the USA account for over a third of studies globally, and the only emerging economies to feature in top 10 are publications from institutions in China and Brazil (Figure 2). Some examples of globally leading research institutions in

30 <https://www.gfsp.org/portfolio/global-food-safety-curriculum-development-initiative>

31 Up to February 2021

this area are IUFoST, CGIAR, University of Maryland (JIFSAN³²), Michigan State University, US FDA, University of Guelph, and Cornell University. The journals *Food Control*, *Journal of Food Protection*, and *British Food Journal* publish a significant number of food safety M&E studies.

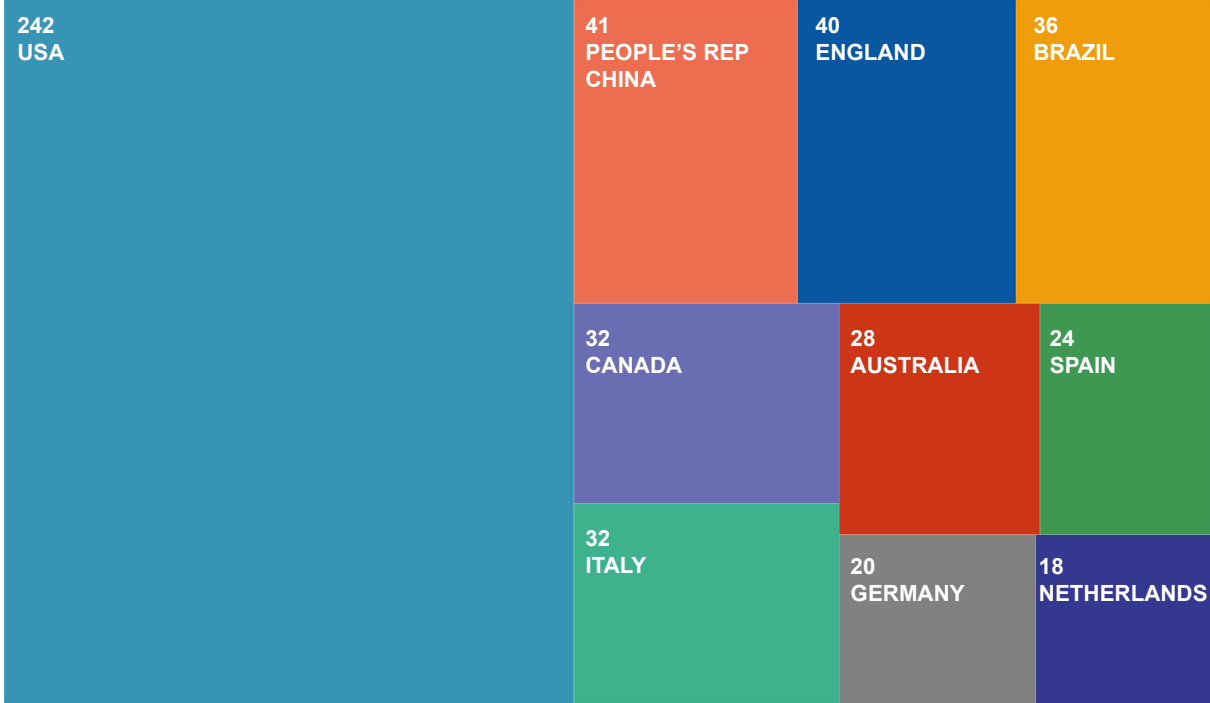


Figure 2: Top 10 countries by publications in the area of “food safety training and education, monitoring and evaluation” (Web of Science search January 2021)

3.2.1 Key studies from LMICs

Despite the number of studies (647) returned in the initial literature search only a relatively small number (30 studies) specifically focused on the measurement of food safety training interventions. Of these, 11 studies measured the impact of training programmes in LMICs (see Table 7 for overview).

The types of study have generally been focused on the measurement of impacts of specific training interventions for food handlers in schools and hospitals, and street vendors, doing a before-after comparison. Only one study measured the effectiveness of different delivery methods for food safety training [2].

32 The Joint Institute for Food Safety and Applied Nutrition (JIFSAN) was established between the United States Food and Drug Administration (FDA) and the University of Maryland (UM) in April 1996. See <https://jifsan.umd.edu/about>

Table 7: Eleven studies of food safety training M&E studies in LMICs

| Country (year) | Sector | Type of training programme | What measured / method | Results and conclusion | Source (page 42-43) |
|-------------------|---|---|---|---|---------------------|
| Bangladesh (2020) | Baking industry | Every recruited worker in the industry receives two days food safety training. Monthly hygiene and sanitation training is common for all floor workers. A basic HACCP, SOP, and ISO related training are compulsory for every employee each year that is also led by a trained auditor. | Comparison of trained vs newly recruited untrained workers. Self-administered questionnaire (160 trained vs 55 new untrained). | Level of knowledge, attitudes, and self-reported practices all significantly higher for trained workers compared to untrained. However, self-reported practices were still below desired level. In this study, the trained respondents do not effectively translate their knowledge and attitude into self-reported practices. | [3] |
| Brazil (2013) | Schools | A programme was developed and implemented in all the schools over two years that was comprised of three steps: 1) theoretical training, 2) implementation of action plans in situ and 3) weekly visits to motivate food handlers and monitor good practices. | School meal services for 68 public schools were assessed every three months with a checklist, which resulted in eight evaluations over two years. | The systematic intervention strategy proposed by the present study was effective in improving school meal services' adequacy in terms of food service hygiene laws. There was a reduction in the overall adequacy percentage after food handlers' holiday periods. | [4] |
| Brazil (2014) | Food handlers in kiosks, restaurants, schools and hospitals | Measurement of participants food safety training background, knowledge assessment, and how this correlates with attitudes and observed behaviours. | 183 randomly selected food handlers. Structured questionnaire and observed practices. | Food handlers who had undergone training presented higher knowledge scores, but did not differ from those who had not, regarding attitudes, self-reported practices and observed practices. The current wording of Brazilian legislation motivates food handlers to undergo training only for certification. Food safety laws should not only require certification but also enable the establishment of policies to monitor and ensure the adequacy of food services. | [5] |
| China (2014) | Schools | Effectiveness of a school-based nutrition and food safety education programme among primary and junior high school students. | A mixed study design incorporating an intervention study and a quantitative survey. Intervention group (n = 501), control group (n = 522). | Food safety scores of the post-intervention were higher than that of the control group in both pre-intervention and nine-month follow-up. It is effective to improve nutrition and food safety knowledge among primary and junior high school students through school-based nutrition and food safety education programmes. | [6] |

Table 7 contd: Eleven studies of food safety training M&E studies in LMICs

| Country (year) | Sector | Type of training programme | What measured / method | Results and conclusion | Source (page 42-43) |
|-----------------|--------------------------|--|---|---|---------------------|
| Egypt (2008) | Hospitals | On-the-job food safety training was given to 23 food handlers. Food safety leaflets were distributed to all handlers and posters were used to demonstrate the importance of safe food handling practices. The results of bacteriological analysis of food samples and swabs were used to draw the attention of the handlers to certain inadequacies during their food handling. | Food safety knowledge questionnaire and food handling checklist effect of the training programme. Samples of patients' meals and swabs from food contact surfaces were again collected. | There was an improvement in the food safety practices in both hospitals. The bacteriological quality of most patient meals and food preparation surfaces and utensils improved after training. | [7] |
| India (2008) | Medical college catering | Assessed change in knowledge, attitudes, and self-reported hand-washing practices of 136 food handlers three months after providing them health education using posters and interactive sessions using a flip chart. | Baseline survey, including semi-structured and Likert type questions. Follow-up survey following intervention. | Significant increase in knowledge about hand hygiene measures, namely, washing hands before handling food (23.5% to 65.4%) and keeping nails cut and clean (8.1% to 57.4%), was observed. Self-reported hygiene improved following the intervention though not to the desired extent. | [8] |
| India (2011) | Street vendors | The training programme comprised of 15 sessions each four-hours long. For all the training sessions various training methodologies and materials were employed like charts, flip charts, posters, motivational video films, role plays, demonstration, puppet shows and handouts. | 80 street food vendors were provided with training to evaluate the existing knowledge, attitude and practice (KAP) regarding food safety and hygiene and the change of the same after training interventions. | The knowledge level of the food vendors increased from an average 24.4% to 66.2% after training interventions. The practice of street food vendors improved to some degree; the highest changes observed in full adoption were in usage of clean vessels for cooked food and drinks, storage of potable water, proper method of serving drinking water as well the food items. There was no change in some practices like usage of ice and sophisticated equipment, due to the vendors being too poor to be able to provide these facilities. | [9] |
| Malaysia (2000) | Street vendors | No training intervention, though survey into cultural background and impact on food safety knowledge and attitudes. | 100 street vendors interviewed using structured interviews. | Differences in knowledge of the ethnic groups were in cross-contamination, equipment, utensils and premises, personal hygiene, hazard analysis critical control point (HACCP) and food regulations and control. Malay and Indian vendors had better educational background, hence better knowledge and attitude scores than Chinese. | [10] |

Table 7 contd: Eleven studies of food safety training M&E studies in LMICs

| Country (year) | Sector | Type of training programme | What measured / method | Results and conclusion | Source (page 42-43) |
|-----------------|------------------------|---|--|---|---------------------|
| Thailand (2005) | Hospital catering | An education programme on the acquisition of the pathogens and their prevention were given by lecture and distribution of handouts. | Efficacy of the education programme was evaluated by assessing the knowledge and the presence of pathogens before and after the education programme. | Diarrhoeal diseases were common in food handlers and their relatives. Before the programme, 40.8% had intestinal pathogens, bacteria and parasites in almost similar proportions. The present study showed a high prevalence rate of intestinal pathogens in food handlers of a tertiary care hospital. The education programme failed to improve their knowledge and hand hygiene practice for the prevention of the pathogens. | [11] |
| Turkey (2008) | Hospital catering | The training consisted of theoretical presentations on "personal hygiene", "food hygiene" and "hand-washing". 83 staff handling food at the kitchens were included in the study. | Questionnaire evaluation of knowledge and self-reported behaviours of the participants before and after the training. The bacteria density of the left hand was analysed as a quantitative indicator of the subjects' self-reported behaviours on food and personal hygiene. | The only behaviour showing a statistically significant change ($p < 0.04$) was using watches, jewellery, etc. during work. Total number of colonies, growing on the participants' hands, had decreased ($p > 0.05$). | [12] |
| Vietnam (2013) | Caregivers of children | Designed an intervention programme to promote behaviour change through educational messages linking diarrhoea to food hygiene and food safety (FHFS) behaviours. Provided FHFS messages through five information education communication (IEC) channels: workshops, newsletters, loudspeaker announcements, bulletin boards, and flip chart communication. | Changes in childhood diarrhoea prevalence, IEC coverage, and food hygiene and food safety behaviours were assessed over a two-year period. Baseline data were collected in January 2006 (n = 125). 1st set of evaluation data in January 2007 (n = 132). 2nd set of evaluation data in January 2008 (n = 185). | Childhood diarrhoea was significantly reduced from 21.6% at baseline to 7.6% at the 1st post-intervention evaluation ($P = 0.002$), and to 5.9% at the 2nd evaluation. Among 17 food hygiene and food safety behaviours measured, a total of 11 behaviours were improved or maintained by the 2nd evaluation. Handwashing after toilet use was significantly improved at both evaluation points. Flip chart communication by community groups was identified to be the most effective IEC channel for effecting behaviour change. | [2] |

3.2.2 Key findings from previous M&E reviews

In the context of the overarching aims and objectives of this review, evidence from the peer-reviewed literature linking food safety training to reductions in food safety incidents is non-existent. The absence of evidence does not mean training interventions are not having a positive effect at some level. However, the task of linking specific interventions to food safety outcomes (other than improvements in knowledge, attitudes or observed behaviours) is methodologically challenging due to the scale at which food safety incidents are often recorded (i.e. at a national level, annually) compared with interventions which are typically implemented and measured at business level.

However, if the question is reframed to examine the impacts of food safety training on business level outcomes, there have been a few published reviews:

- a review of food safety and food hygiene training studies in the commercial sector [13]
- a systematic review of the methodological strategies adopted by food safety training programmes for food service workers [14]
- meta-analysis of food safety training on hand hygiene knowledge and attitudes among food handlers [15]; and
- efficacy of food safety training in commercial food service [16].

Some of the key findings of these papers are now discussed.



Lack of substantial evidence on effectiveness of food safety training

Most studies consisted of a single short-term before-after comparison, with limited information provided on how training interventions were measured. Only a few longitudinal (multi-year) studies were identified, and fewer still compared different types of training intervention and context of delivery. Studies of longer-term intervention and evaluation are needed to meaningfully assess behavioural change [13].

There is also a lack of information on the costs-benefits of different types of training intervention, level of training (basic vs advanced), as well as other contextual factors that impact on training success such as the availability of tools and equipment, motivation, and cultural dimensions [13]. Employee attitude is an important dimension that is often overlooked, and key to understanding the food safety culture of an organisation and where meaningful interventions might be made (see Table 7).

A review of commercial food service training identified that best practice of ensuring effective training and follow-up was using food safety training programmes which incorporated both knowledge and behaviour-based training [16].

Training that just relies on the presentation of science-based facts and assessment can also ignore the organisational food safety culture and context. Employee attitudes, beliefs, and motivation are more influential in shaping food safety behaviour than just knowledge alone [16]. For example, time pressures during busy periods may mean “rules have to be bent to get the job done”, or workers may feel pressured to come into work if they feel ill. Thus, a good food safety culture has to be fostered by the business leadership.

Embedding good practices

Refresher training is essential for proper food safety behaviour [15][16]. Training should not be a one-time occurrence and behaviour has potential to be improved through regular refreshing training. In the context of food handlers, monitoring of both knowledge and skills should be undertaken frequently by managers [15]. Standard training plus behavioural interventions (e.g. incentive rewards, management support, and reminders) are the best way of improving handler performance [15].

Need to focus on training the trainer (i.e. managers)

Training of managers is seen by many as fundamental to the implementation of realistic food safety practices within the workplace [13]. If managers are trained to advanced levels they can provide basic training for food handlers in-house and tailor training according to the context of their business.

In the context of commercial food service, at busy periods, knowledge-based training is often not enough to trigger proper handwashing techniques (i.e. employees are too busy distracted with other tasks). In this case, managers need to be fundamentally aware of other work factors that could impinge on food safety and look at ways of adjusting employee workload and improving employee motivation. This could be through recognising, rewarding and encouraging employees for their efforts [16].



Other sources of information to be further explored

Generally, detailed evidence from the scientific literature is lacking with regards to understanding the factors that contribute to successful food safety outcomes [13]. Further research is needed on factors such as course content, the site of training, duration of courses and frequency of refresher training. A source of evidence that could be further explored is M&E data of internal training that may sit within businesses (Figures 3 and 4), and also that which may sit within certification / inspection bodies and third-party certification programme audit reports.

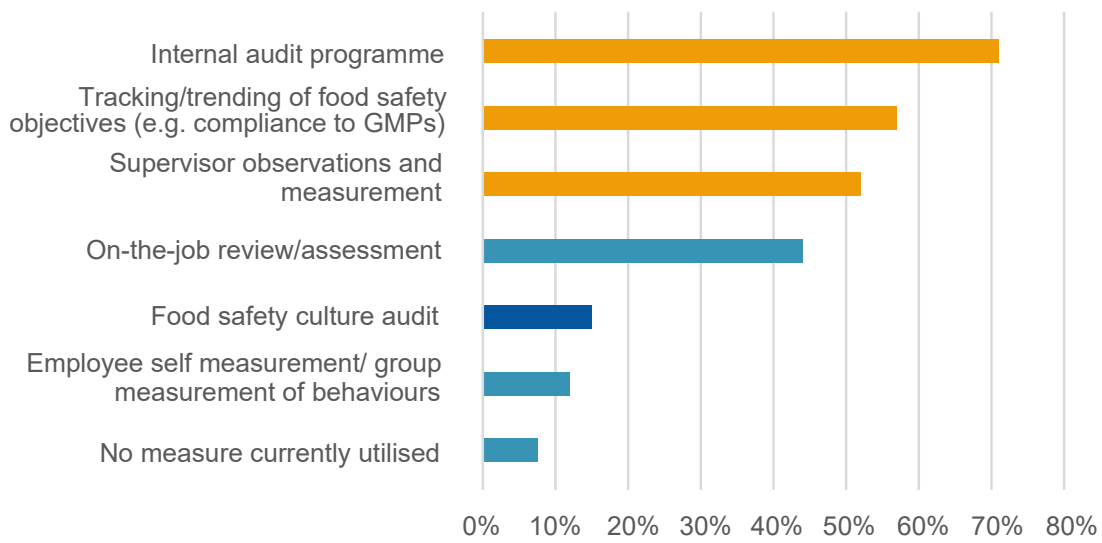


Figure 3: How sustained positive food safety behaviours is "measured".
Global Food Safety Training Survey 2017 (Source: Campden BRI³³)

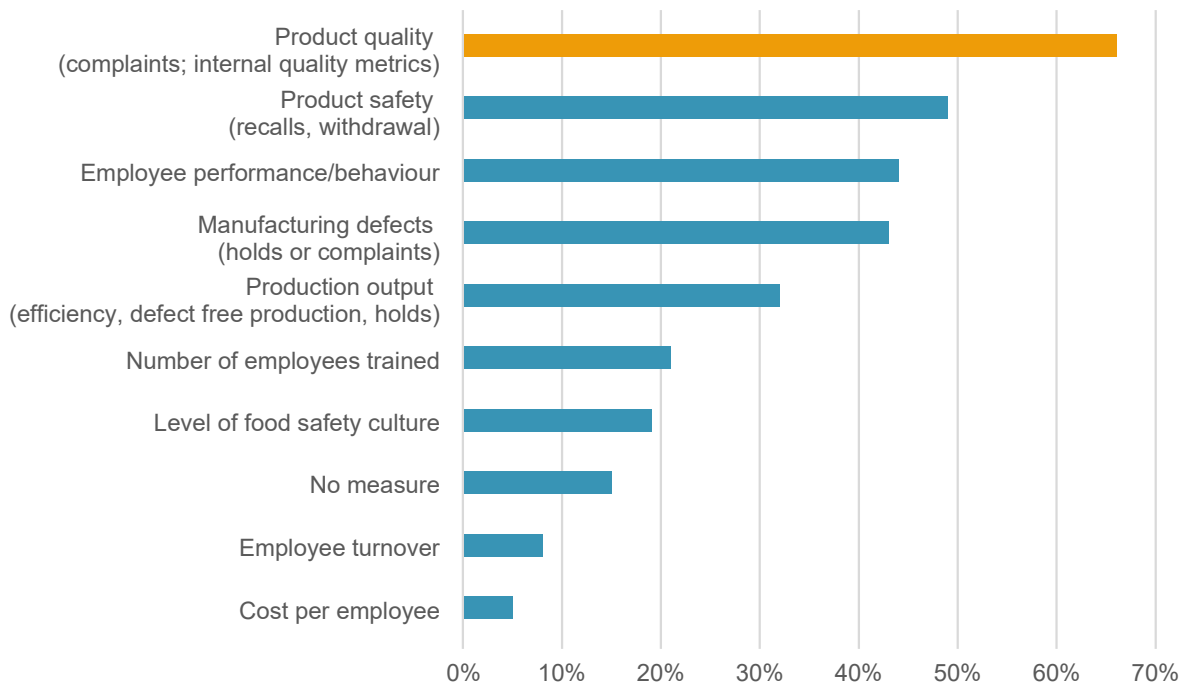


Figure 4: How the value of training is measured.
Global Food Safety Training Survey 2017 (Source: Campden BRI³¹)

33 <https://www.campdenbri.co.uk/training/globalfoodsafetytrainingsurvey2017.pdf>

There may also be a substantial number of studies in the ‘grey literature’ (outside academic channels) on food safety M&E programmes that could be investigated further (see Section 5). For example, the UK Food Standards Agency undertook a statistical analysis of the relationship between compliance with food hygiene law and food safety³⁴ to assess:

- the relationship between food business compliance and microbiological contamination sample outcomes; and
- the relationship between food business compliance and identified foodborne disease outbreaks.

Although it was found that compliance with food hygiene law does not eliminate the risk of outbreaks or unsatisfactory sample results, its analysis found that premises with higher food hygiene ratings are less likely to experience food safety incidents.

An additional consideration in the evaluation of training programmes is that any analysis will need to take into account that training will be one-step removed from national level data on food safety incidents (Figure 5).

Therefore, in the context of the development of M&E programmes, sufficient thought needs to be spent on developing the M&E framework and hypotheses for testing; i.e. the success of training will be reflected in improved business compliance (measured through inspections), and businesses with a high level of compliance will have a lower number of food safety incidents (measured through the analysis of national datasets) (see Annex 8).



Figure 5: Food safety training is indirectly linked to improvements in food safety incidents

34 For further details see <https://www.food.gov.uk/research/research-projects/evidence-of-relationship-between-food-business-hygiene-compliance-and-measures-of-food-safety>

4. Main discussion points from interviews and information review

In this section the key themes from the expert interviews are explored and structured in a logical manner as to the strategic planning of food safety programmes. This links to the third question in the aims and objectives of this study: How can these programmes be applied in a variety of cultural / social contexts? (Section 4.1). This is followed by a deeper examination on training delivery (Section 4.2). This has also been informed by previous food safety reviews [1].

4.1 Developing food safety programmes for different cultural / social contexts

SUMMARY

- Incentives for enhancing food safety management capacity vary depending on where a country falls in the food safety life cycle.
- Poorer consumers and the politically marginalised are likely to be most at risk of exposure to foodborne disease, as domestic consumption is largely driven through wet markets and street vendors.
- Before designing any training programme (irrespective of it being implemented at a business level or nationally), a key first step is to understand the specific risks through benchmarking.
- Many of the poorest countries are caught in a low-level capacity trap in which political (e.g. pressure from citizens and advocacy groups) and market incentives (e.g. export markets and trade requirements) to build capacity are weak.
- In wealthier countries there are trends towards partnerships between business and government, moving away from the strict policing function of government, with a focus on punishing less and facilitating more.
- The systematic monitoring and evaluation (M&E) of food safety programmes is sparse. In LMICs there may be a critical lack of resource and capability for collecting food safety data.
- A working paper on the food safety metrics relevant to LMICs states that 'health measures based on appropriate metrics, can support rational resource allocation, enhance accountability, facilitate comparison, help in monitoring progress and exert pressure to improve performance. However, at the same time they can be prone to manipulation, and their implementation may entail more costs than benefits' [18].

As shown in Section 3 there are several organisations with an interest in developing food safety training and capacity building programmes, with often overlapping remits leading to inter-institutional politics and resource inefficiencies in funding and delivery of programmes. Therefore, it is imperative that partnerships form between key institutions, allowing resources and information to be shared and allocated efficiently.

Country context – the food safety life cycle

Having an understanding of where a country falls on the food safety life cycle (i.e. in the traditional, transitioning, modernising or postmodern phase) is important [1], as evidence shows that different types of food safety risks vary systematically with the level of economic development (Figure 6 and see Annex 5). Incentives for enhancing food safety management capacity vary depending on where a country falls in this cycle. Developing food safety programmes need to be aligned with the wider development agenda and policy priorities for the country (e.g. food access, clean water, other public health priorities, to growing exports / imports and targeted support to economically significant sectors) and what is possible from a regulatory and governance perspective.

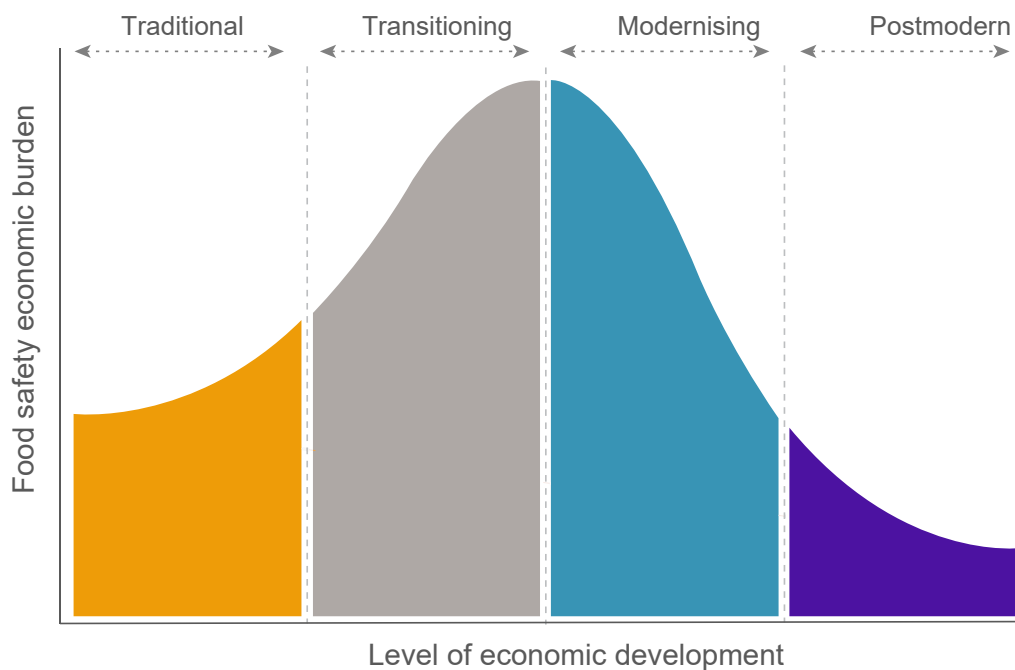


Figure 6: Food safety life cycle with levels of economic development (source: World Bank)

In countries in economic transition from a least developed status, the focus of food safety starts shifting from concerns over food and nutritional security, to more closely linking with the efforts to promote agricultural transformation and food trade competitiveness. This can cause a gap in country capacity and need, with any food safety capacity shifting towards serving export and urban middleclass markets, with the domestic regulatory apparatus quickly becoming overwhelmed by rising food safety incidents [1].

The transitioning of economies from traditional societies largely reliant on local food production systems to one increasingly reliant on imports, means traditional eating practices that often-addressed food safety fundamentals (eating food fresh, curing / drying proteins to allow storage, cooking food properly) are often replaced by rapid changes in diet. This can lead to loss of traditional practices and tacit food safety knowledge at a household level. Poorer consumers and the politically marginalised are likely to be most at risk of exposure to foodborne disease, as domestic consumption is largely driven through wet markets³⁵ and street vendors [1].

³⁵ A market that sells perishable items (such as fresh meat and produce) and sometimes live animals which are often slaughtered on-site

Risk and needs assessment

Before designing any training programme (irrespective of it being implemented at a business level or nationally), a key first step is to understand the specific risks through benchmarking. For example, at a country-level, the Food Safety Performance World Ranking [17], has been developed to assess 10 food safety performance indicators falling under three food safety risk governance domains:

- Food safety risk assessment - recognised as a science-based process that assesses exposure and characterises food safety risks. Indicators explore chemical risks, microbial risks, and national reporting on food consumption.
- Food safety risk management - which is both a policy-based and a commercially-based process to prevent, control, and mitigate risks while ensuring health protection and fair-trade practices. Selected indicators include national food safety capacity, food recalls, food traceability, and radionuclides standards.
- Food safety risk communication - or the exchange of information and opinions around food safety risks (actual or perceived). Indicators include allergenic risks and public trust.

One means of achieving an exchange of information would be to develop a global food safety information platform, involving cataloguing and verification of different resources. This could start out as a resource for a specific sector (e.g. wet markets) and then be expanded.



In respect of food safety knowledge and capacity, IUFOST carries out strategic global reviews on specific Food Science and Technology (FS&T) Challenges. In 2014, they carried a global mapping exercise to better understand FS&T capability in different regions³⁶. They found that in many countries, several ministries and government agencies with different objectives supported research and training in FS&T, which means inputs are fragmented, with lack of coherent strategies on how to develop their domestic FS&T capacity.

The most serious problems were identified in Africa, where FS&T capacity is not developing. FS&T in formal and higher education is poorly recognised in LMICs in this continent, where even basic training is weak. Countries in the northern hemisphere are also not immune to FS&T capacity challenges, where FS&T is being “squeezed out” by other priorities, with lack of attention weakening the science base and reducing career opportunities for researchers, and reducing the attraction of the food and drink sector to high quality early career scientists.

³⁶ See <http://www.iufost.org/sites/default/files/global-visions-report.pdf>

In the context of animal-based food production, the World Bank has identified countries with the biggest gap between food safety need and capacity, by income group (see Annex 7). The top-10 countries, with the largest gaps, comprise LMICs (including six upper-middle income countries).

Perhaps unsurprisingly, many of the poorest countries are caught in a low-level capacity trap in which political (e.g. pressure from citizens and advocacy groups) and market incentives (e.g. export markets and trade requirements) to build capacity are weak [1]. This is because many of the critical capabilities that generate and support these incentives, including effective food safety risk assessment and public health reporting, are missing. A few interviewees also raised the problem of 'brain drain', where the most capable students would undertake scholarships overseas and settle in countries with an improved quality of life. Developing student sponsorship programmes, providing funded places at local universities which could tie in with IUFOST activities, could help combat this issue. Supporting the continued development of food safety networks, working with IUFOST, and facilitating knowledge sharing through sponsoring workshops, webinars etc., will benefit capacity building.

Professionalisation, which is generally achieved through a combination of training and complementary interventions, works through the “induction” of trainees into a professional group and identity. It is also a way of raising the profile of a sector to retain talent [1].

Building partnerships and networks

A key determining factor to the legacy of any successful food safety programme is the extent to which there is ongoing commitment from project partners to ensure that the programme is sufficiently embedded within the food safety governance structures of the country. The WHO have conceptualised this as a tri-partite partnership between government, business and the consumer (Figure 7).

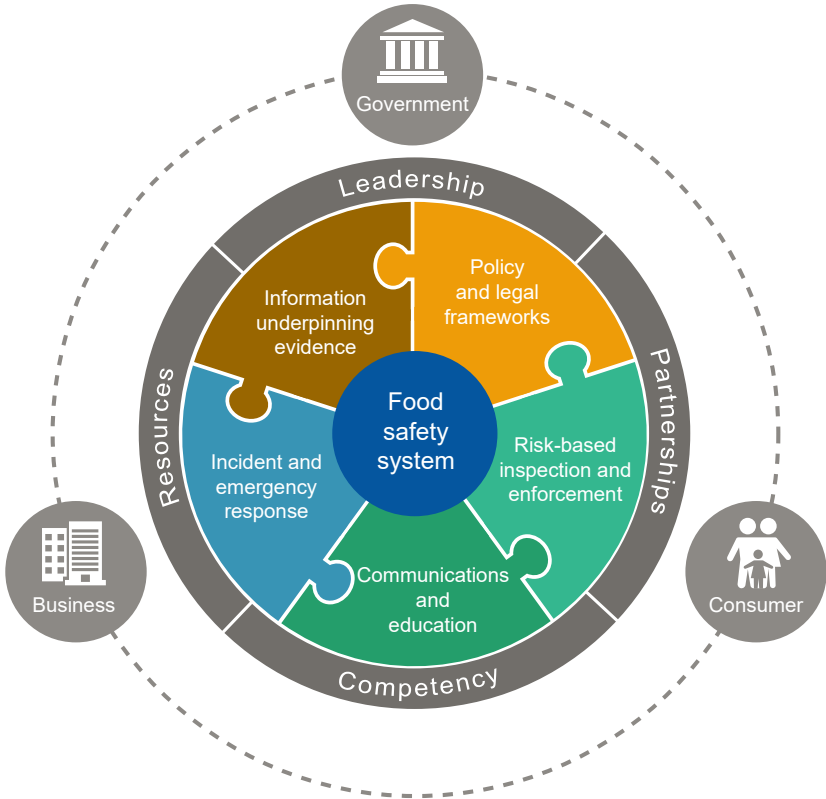


Figure 7: Framework for action on food safety [1]

One key aspect of any successful partnership is trust and this strongly influences the relationship between different actors in a food safety system. The key attributes of a trustworthy food safety system include competency, transparency, and accountability [1]. Traditionally, regulatory systems have been aimed at changing or controlling the behaviour of businesses in a way that either avoid damage or help create desired public goods. In wealthier countries there have been trends towards partnerships between business and government, moving away from the strict policing function of government, with a focus on punishing less and facilitating more [1]. Jaffee et al argue that this can be achieved through redefining institutional roles to provide information, advice, incentives, and interventions to motivate and leverage investments and actions by value chain actors [1].

Monitoring and evaluation frameworks and metrics

Whilst many developed countries will have food safety event-and-recall information systems, the systematic monitoring and evaluation (M&E) of food safety programmes is sparse. In LMICs there may be a critical lack of resource and capability for collecting food safety data. It may also be due to performance indicators in these countries being more focused on policing outcomes (e.g. value of fines collected, number of infringements and businesses closed) rather than focused on food safety outcomes (e.g. magnitude of food safety risks, incidents of foodborne disease, standards-compliant trade) [1].

A working paper on the food safety metrics relevant to LMICs states that 'health measures based on appropriate metrics, can support rational resource allocation, enhance accountability, facilitate comparison, help in monitoring progress and exert pressure to improve performance. However, at the same time they can be prone to manipulation, and their implementation may entail more costs than benefits' [18].

Measures to enhance food safety programmes in LMICs could include:

- conducting a wider cost-benefit review of the various types of different training intervention, including working with third-party standard owners, training providers, and certification bodies to synthesise knowledge that sits outside the formal academic literature
- administering a standardised questionnaire through regional food safety networks and IUFOST to get a better understanding of the food safety training landscape at a regional level (i.e. accessibility to information, training providers, scope for professional development etc.); and
- developing practical guidance on how to establish M&E systems for different contexts and scales (e.g. business level through to country-wide initiatives).

There are a few conceptual frameworks that have been developed for establishing effective M&E frameworks (See Annexes 8 and 9). Grace et al provide some useful principles on the appropriate good design of food safety measures and metrics [18]:

- A strategic plan must precede the development of measures with clear and realisable goals and practical steps for implementation, including metrics. It is important to align the measure with the desired goal and communicate the goal not just the measure.
- When a measure becomes a target, it ceases to be a good measure. Targets should therefore be designed with the possibility of 'playing the system' in mind and avoid using metrics as performance targets.
- Food safety is complex and single measures can be misleading. Therefore, multiple indicators are needed to obtain a comprehensive measure that describes food safety.
- Measures should assess outcomes and impact as well as processes.

- Measures should be designed in a way that they encourage actions to improve outcomes. A poorly designed measure will encourage actions to achieve high scores.
- The context of measures should be considered; if significant changes outside the control of the agency are occurring (e.g. migration or climate change) then metrics should be interpreted in light of this.
- Measures should be easily understood and accepted by a range of stakeholders and the underlying data should be widely available.
- Measurements have costs and the benefits should be demonstrated to outweigh the costs.

The metrics and indicators for measuring the impact will differ between programme scale (organisational vs sector vs a supply chain vs whole industry) and context. For example, in the context of individual business continuous improvement, the University of Central Lancashire has been using technology to gather weekly feedback from employees. Based on this feedback, small, tailored interventions are implemented on a weekly basis, allowing improvements to accrue gradually overtime.

4.2 Developing food safety training and education programmes

SUMMARY

- A food safety programme could involve both a combination of formal and informal training initiatives, organised into broad activity areas.
- For formal food safety education programmes, IUFoST has led the development of an undergraduate food safety curriculum (Annex 4) and Masters programme in food safety leadership. These curricula can be tailored accordingly to the context of different countries and specific food safety challenges encountered.
- Formal training can also be used to develop the technical skills and knowledge within large-scale commercially orientated producers and food inspectorate community.
- Informal training can be used to engage with smaller-scale producers who may be serving domestic markets and where delivery of formal training may not be practical or cost-effective.
- Informal training could involve information and advocacy campaigns run by food safety networks. The dissemination of good practice (e.g. food safety fundamentals of clean, separate, cook, chill) throughout early years and school education, and promotion around special events and holidays, could also ensure good practice and food safe attitudes are embedded at a population level.
- At a business level, training requirements will be driven by market and regulatory requirements. Training middle-tier managers to administer training to frontline workers will be key to scaling impacts (i.e. the 'train the trainer' approach).
- The success of specific training activities will be very much dependent on three factors; a clear message, that is delivered engagingly, by a respected person (or institution).
- Another key consideration is the impact of national cultures on the different methods of learning and training [19], and programmes should be tailored accordingly by working with educators who have a good understanding of local culture.

Target audience

From a food safety awareness / education perspective export markets (particularly those to Europe, North America and Australia) should have high levels of employee training, due to the regulatory incentives to have robust systems in place to meet export market requirements and third-party certification requirements. Key risks will remain in food fraud³⁷, with priorities being focused on building capacity in compliance and enforcement and tackling corruption in high-risk sectors.

Going back to Table 3 (page 10), the distinction between the OECD definitions of formal vs informal education needs to be kept in mind. For formal food safety education, IUFoST has led the development of an undergraduate food safety curriculum (Annex 4) and Masters programme in food safety leadership. These curricula can be tailored accordingly to the context of different countries and specific food safety challenges encountered, with IUFoST serving an ongoing accreditation role.

Informal training could involve information and advocacy campaigns run by food safety networks (for example, the USA Partnership for Food Safety Education (PFSE) FightBAC initiative). The dissemination of good practice (e.g. food safety fundamentals of clean, separate, cook, chill) throughout early years and school education, and promotion around special events and holidays, could also ensure good practice and food safe attitudes are embedded at a population level. Working with country school education programmes and developing teaching platforms similar to those in the UK and USA would benefit food safety programmes in LMICs. This could involve developing a food safety resource toolkit that essentially takes the best bits from different initiatives globally that can then be used /tailored at local levels.

At a business level, training requirements will be driven by market and regulatory requirements. For food handlers, training on food safety basics is often essential, particularly in factories or food service outlets that will often have a high staff turnover. Training middle-tier managers to administer training to frontline workers will be key to scaling impacts (i.e. the 'train the trainer' approach).



³⁷ For example, see EU reporting on this https://knowledge4policy.ec.europa.eu/food-fraud-quality/monthly-food-fraud-summary-reports_en

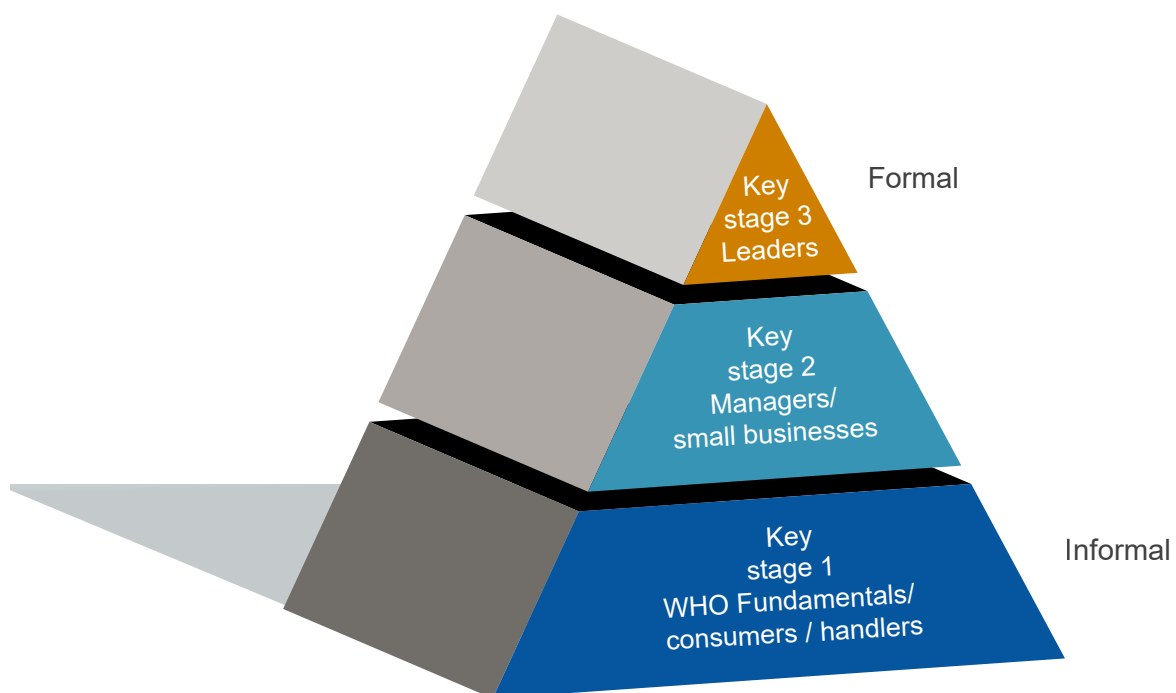


Figure 8: Basic visualisation of the key components of a food safety programme

A food safety programme could involve both a combination of formal and informal training initiatives, organised into broad activity areas (Figure 8). Formal training can be used to develop the technical skills and knowledge within large-scale commercially orientated producers and the food inspectorate community. Informal training can be used to engage with smaller-scale producers who may be serving domestic markets and where delivery of formal training may not be practical or cost-effective.

Food safety interventions could be targeted for specific 'at risk' sectors – sectors that are a bio-security concern (e.g. wet markets, livestock producers), at risk from climate change impacts (e.g. primary producers in the tropics), and those intrinsically risky from a food handling perspective (e.g. last mile delivery, food service). Work within existing food safety networks, to further build communications expertise, and targeted messaging campaigns (e.g. farm radio) could also focus on 'at risk' sectors.

Delivery

The success of specific training activities will be very much dependent on three factors:

- The message – is it easy to understand by the intended audience and what this means for changing behaviours? For example, consumer focused programmes are often based on a simple message that is reiterated through different delivery channels.
- The mode of delivery – many studies have suggested that training courses that are more interactive and activity-led have better uptake by employees [19]. Other types of delivery, such as 'farm radio' and TV advertisement campaigns could be a means of reaching a large audience.
- The messenger – delivery by a respected and trusted person will likely lead to better results [2]. For train the trainer programmes, this allows managers to deliver training that can be tailored towards the operational context of their business.

At a business level, the Global Food Safety Training Survey suggests that for most businesses training is delivered internally, either through learning on the job, or classroom training. External training providers are only used by around 30% of businesses surveyed (Figure 9).

Another key consideration is the impact of national cultures on the different methods of learning and training [19] and programmes should be tailored accordingly by working with educators who have a good understanding of local culture.

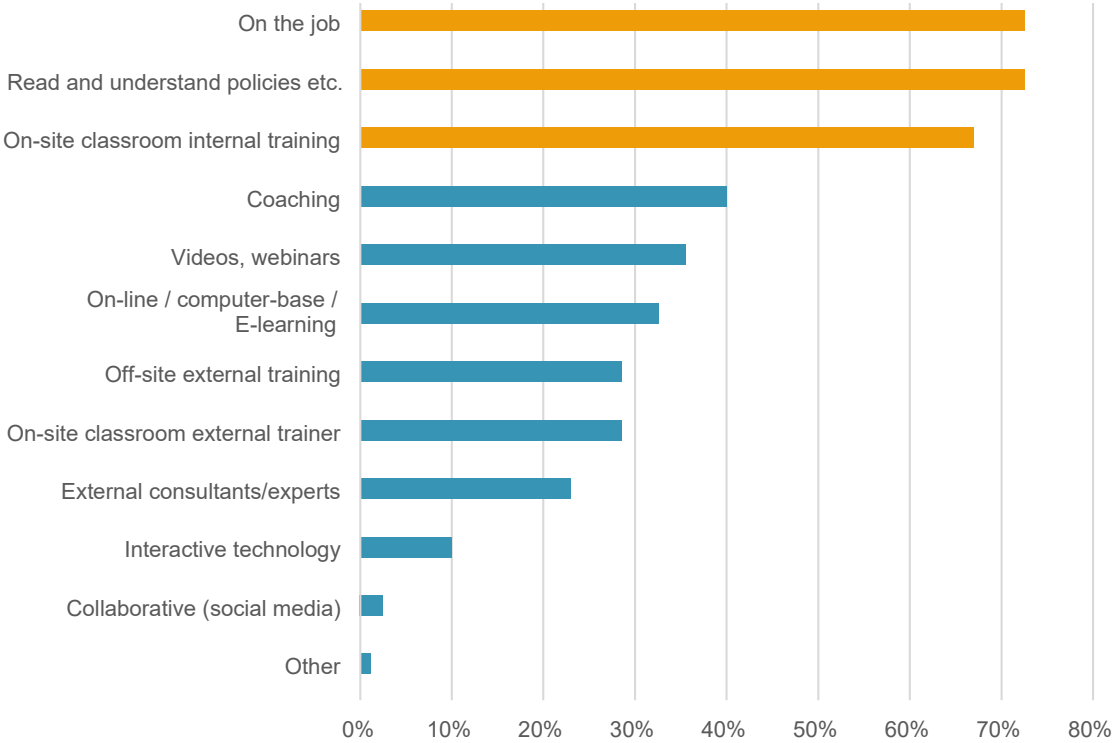


Figure 9: How is food safety training delivered.
From the Global Food Safety Training Survey 2017 (Source: Campden BRI)

5. Conclusion

This review has provided insights against three questions:

1. What types of food safety and training programmes feature at a global level?

Several food safety programmes have been identified, with leading initiatives being run through organisations such as the FAO, WHO, World Bank, IUFOST, and the GFSI. The programmes of these international and regional networks are often linked with a food science R&D infrastructure provided by in-country university and technology institutions. There may also be partnership building between countries, whereby a country will lend resource to build capacity in its partner, this is often linked to trade and market access. Additionally, private sector initiatives such as the GFSI Global Markets Programme and examples of public programmes (e.g. household food safety campaigns, school and university curriculums, and targeted interventions) were also identified.

2. To what extent do these programmes have a demonstrable impact on reducing foodborne illness and fatalities?

Evidence from the peer-reviewed literature linking food safety training to reductions in food safety incidents is non-existent. This also reflects more generally the lack of established food safety M&E frameworks globally. A body of evidence that could be further explored is M&E data of internal training that may sit within businesses, and also that which may sit within certification / inspection bodies and third-party certification programme audit reports.

3. How can these programmes be applied in a variety of cultural / social contexts?

The food safety life cycle was used to illustrate that food safety risks vary systematically with the level of economic development in a country, and the biggest gap between capacity and need is in countries transitioning from a least developed status to one exporting into global markets. To have lasting impact on the food safety performance in domestic food safety systems in LMICs, broader development factors such as lack of infrastructure, poverty, and levels of literacy will need to be properly taken into account to ensure food safety programmes are inclusive and not just serving the needs of higher-end markets.

It is worth noting that the COVID-19 pandemic has caused a shift to virtual working, including delivery of remote training, and some of these new ways of working are likely here to stay. Whilst technology can certainly play a supporting role, this review has emphasised the need to keep delivery engaging and interactive to maintain interest from participants.

COVID-19 has also caused an increased interest in bio-security issues, this now the focus of FAO (FAO-EMPRES) and World Bank (Food Systems 2030 fund) programmes. Climate change impacts and technology innovation are also going to create risks and opportunities for food systems.

Emerging recommendations

The research informing this report indicates a clear need for a comprehensive framework for evaluating the effectiveness of food safety skills and education programmes that is easily understood, endorsed and accepted by a range of stakeholders. This need is both known to the sector and not easy to achieve: instead, metrics tend to be developed that are appropriate to the needs of specific initiatives or locations.

For a universal framework to be agreed, it is recommended that a series of steps be undertaken, led by Lloyd's Register Foundation and / or other relevant organisation(s). This would involve work with food sector businesses, including processors, retailers, certification bodies, regulators, auditors, academia, private and institutional food safety training service providers, and international organisations (such as the FAO, WHO, Codex) to:

- identify informal publications ('grey literature') arising from food safety evaluation programmes, which may reveal new insight into evaluation approaches and practice
- drawing on existing knowledge, to define, agree and endorse practical guidance for monitoring and evaluation of food safety training in different contexts and scales; and
- use this practical guidance to support a review of the effectiveness of food safety training.



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Annex 1 – Interview questions

1. Please describe the role of your organisation in food safety training and education.
2. At what stage in the food chain do you provide food safety training / education on (production, processing, consumption)?
3. What types of programme do you offer, and who are your typical clients/ audience?
4. How is training delivered (also pre-Covid) – remote, classroom, work environment, modular?
5. What level of recognition do you offer?
6. How do you monitor the success of your programmes?

Work in developing regions

7. What in your view are the main challenges to improving food safety in less well-developed regions?
8. What in your view would be the key considerations for developing a food safety programme in these regions?
9. Should the focus of these programmes be on the consumer, supply chain, producer, or capacity building within government / education providers / universities?
10. In regions lacking critical infrastructure (e.g. potable water, refrigeration) relevant to food safety, what can be done at an educational level to reduce food safety risks?

Annex 2 – List of stakeholders interviewed

| Sector | Organisation | Contact |
|----------------------------|----------------------------------|------------------------------|
| Regulators / public bodies | Food Safety Authority Ireland | Ruth Conefrey |
| Industry bodies | Seafish | Lee Cooper & Richard Wardell |
| | IAFI | Mark Boulter |
| Universities | Lincoln University | Mathew Thompson |
| | University of Maryland | Clare Narrod |
| | University of Central Lancashire | Prof Carol Ann Wallace* |
| International bodies | FAO | Jeffrey Lejeune |
| Strategic consultancy | Alinea International | Brian Bedard |
| Training providers | Integrity Compliance | Clare Winkel |

* not interviewed, based on IFST webinar on 15th March 2021 where Prof Wallace presented on her work measuring food safety culture.

Annex 3 – Examples of regional food safety networks

| Network | Delivery | | | Intended target audience | | | |
|--|----------|------------|----------|--------------------------|----------|----------|----------|
| | Formal | Non-formal | Informal | National | Academic | Business | Consumer |
| <p>African Food Safety Network (AFoSaN)</p> <p>This is a network of stakeholders uniting to strengthen food safety control systems in Africa with testing laboratories as a foundation. These labs reach out to each other in sharing the latest information on food safety matters including analytical techniques. They also collaborate with others beyond the continents.</p> | | ✓ | ✓ | ✓ | | ✓ | |
| <p>Food Safety Asia</p> <p>A network of food testing laboratories across Asia. Aims to:</p> <ul style="list-style-type: none"> • Establish collaborations among food safety laboratories in the region. • Harmonise laboratory practices / methods related to monitoring of veterinary drug residues and related chemical / natural contaminants in food. • Promote application of nuclear and complementary techniques in the field of food safety. • Enhance interaction of food safety laboratories with non-technical stakeholders. • Establish a network of food safety laboratories in the Asian region that monitor veterinary drug residues and related chemical / natural contaminants. | | ✓ | ✓ | ✓ | | | |
| <p>FAST Food Safety in Latin America and Caribbean</p> <p>(FAST = Food Safety and Agricultural Sustainability Training programme)</p> <p>Through the US Food Safety Modernization Act (FSMA), the Food Safety and Agricultural Sustainability Training program (FAST) programme, focused in Latin America works to promote the goals of FSMA to meet food export requirements to the USA. It strives to strengthen food safety components of sanitary and phytosanitary (SPS) systems in targeted countries,</p> | ✓ | ✓ | ✓ | ✓ | | ✓ | |

Annex 4 – GFSCI core curricula subjects

A Core Curricula Steering Committee established 21 foundational core curricula subjects (based on surveys, online questionnaires, responses from recognised food safety experts, and analysis of other curricula review processes):

1. Biology / microbiology / toxicology
2. Chemistry / analysis
3. Field work
4. Food engineering
5. Food hygiene and sanitation, incorporating plant design
6. Food laws / regulation
7. Food marketing
8. Food packaging
9. Food processing technologies
10. Food safety culture / ethics
11. Food science history and communication
12. Information sources and uses
13. Interface with zoonosis and post harvest, good agricultural practices, handling and distribution practices, sustainable resources and water supply
14. Maths / statistics
15. Nutrition and allergens / bio-chemistry / physiological function of the human body
16. Product development - shelf life, texture, food additives
17. Public health / environmental health / food hazards and diseases
18. Quality assurance
19. Risk analysis
20. Sensory evaluation
21. Traceability and authentication

Annex 5 – Food safety life cycle

Sources of foodborne hazards, by stage of the food safety life cycle

| Foodborne hazard | Stage of food safety life cycle | | | |
|--|---------------------------------|---------------|-------------|-------------|
| | Traditional | Transitioning | Modernising | Post-modern |
| Naturally occurring food toxins | *** | *** | ** | * |
| Livestock zoonoses | **** | *** | *** | * |
| Microbial pathogens | ** | **** | *** | ** |
| Veterinary drug residues | * | ** | ** | * |
| Pesticide residues | * | ** | ** | * |
| Industrial contaminants | * | ** | ** | * |
| Food adulterants | * | ** | ** | * |
| Aquatic zoonoses, parasites and toxins | ** | *** | ** | * |
| Contaminated or adulterated feed | ** | *** | ** | * |
| Food additives | * | ** | ** | * |
| Heavy metals | * | ** | *** | * |

Source: World Bank

Note: * = minimal ** = moderate *** = significant; and **** = major

Annex 6 – Incentives for developing food safety programmes

| Economic unit affected | Types of costs incurred when food safety failures occur | Distribution of costs | Market incentives or regulatory enforcement for food safety | Variations by development level |
|------------------------|---|--|--|--|
| Consumer | Consumers seek substitutes, limit consumption. May pay higher food prices or incur avoidance costs. May influence dietary patterns with negative nutritional consequences. | Foodborne illness is a greater burden on poor people and children. Both acute and chronic illnesses will reduce labour productivity and incomes. | Consumers may not always identify source of hazard and, as a result, may not be able to avoid them. Consumers will look to certification, media reports, public sector for guidance. | Consumer awareness and access to good information about hazard avoidance will be limited in low income countries. Information improves with urbanisation, but this may not always be reliable. Good evidence for public health burden; mixed evidence on willingness to pay. |
| Firm | Lower price for products, loss of both domestic and export markets, loss of firm equity and brand reputation, firm failure. Mitigation may require new investments and recurring costs, including certification. | Small firms may evade detection and impact more likely for larger firms. Per unit costs of mitigation likely higher for small firms. | Consumers shun firm or accept product only with lower price. Export markets may be closed. Formal sector buyers require certification. Regulators impose fines or recall products. Equity prices decline. | Unlikely to be detected at low income levels except in limited way in informal markets. Buyer incentives more likely as markets urbanise. Export market failures can occur at any income level. Firm equity impacts only in high income countries with larger firms. |
| Industry | Loss of product reputation is a cost to all firms, even good actors. Lower price or loss of market share relative to substitute products or import suppliers. Loss of export markets or diversion to lower price markets. Limited market expansion. | Firm failure for those unable to comply leads to change in industry structure as smallholders more likely to have higher costs of compliance. | Consumers shun domestic product, make substitutions, or accept only at lower price. Exports markets may require special certification or approval. Regulators may impose new requirements for entire industry with additional costs. Formal sector may impose certification requirements. | More likely as markets develop and regulators discover problems, which are then reported in the media. More likely if product is also exported, as problems in meeting high income standards become known. |
| Food sector | Limited expansion of supply for products associated with failures, with resulting losses for producers. | May bias sector development toward processed or imported products. May bias food safety investments toward high value exports with little spillover for domestic quality. | Incentives are subtler at this level and these effects would only appear over time. | More likely to be experienced as countries pass through the middle income stage of market development. |
| Economy | Limited food sector development, especially processing and high value exports. Burden of foodborne illness reduces labour productivity and output across all sectors. Increased food imports and / or reduced exports reduce government revenues. | May limit opportunity for smallholders, women in food processing. May skew direction of structural transformation in agriculture and food with possible negative consequences for income distribution. | Incentives subtler and shift toward fewer high risk commodities in production and consumption would occur over time. Food trade balance impacts also likely to accrue slowly over time. Burden of foodborne illness often hidden and impacts of better health on productivity are hard to measure. | Public health burden hidden but likely more significant at low income levels. Consequences for structural transformation emerge as countries pass through the middle income stage. |

Source: World Bank

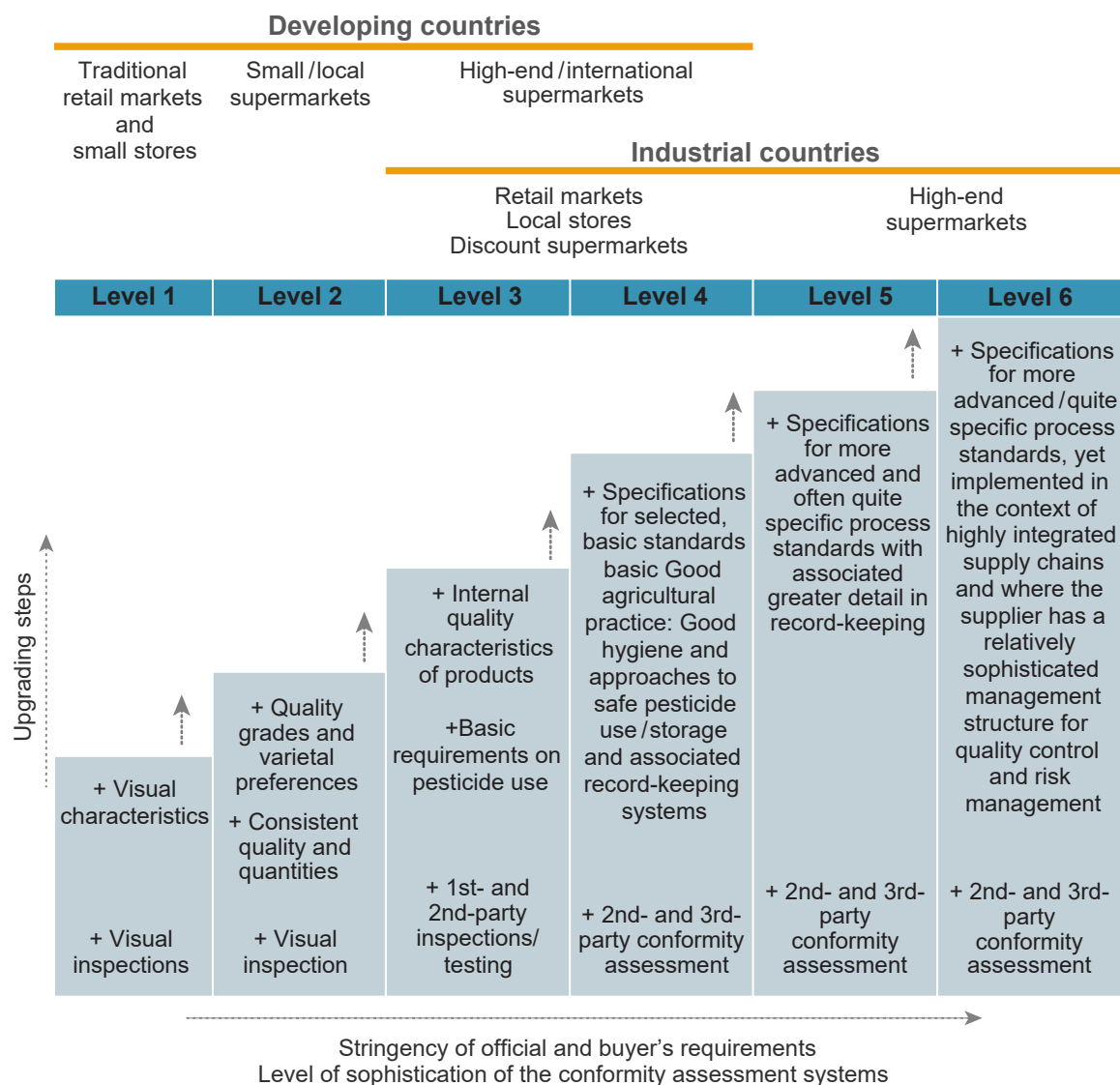


Figure A6.1 Smallholder farmers, agricultural markets, and varied conformity requirements
 (Source: Jaffee et al. 2019 [1])

Annex 7 – Gap between food safety need and capacity

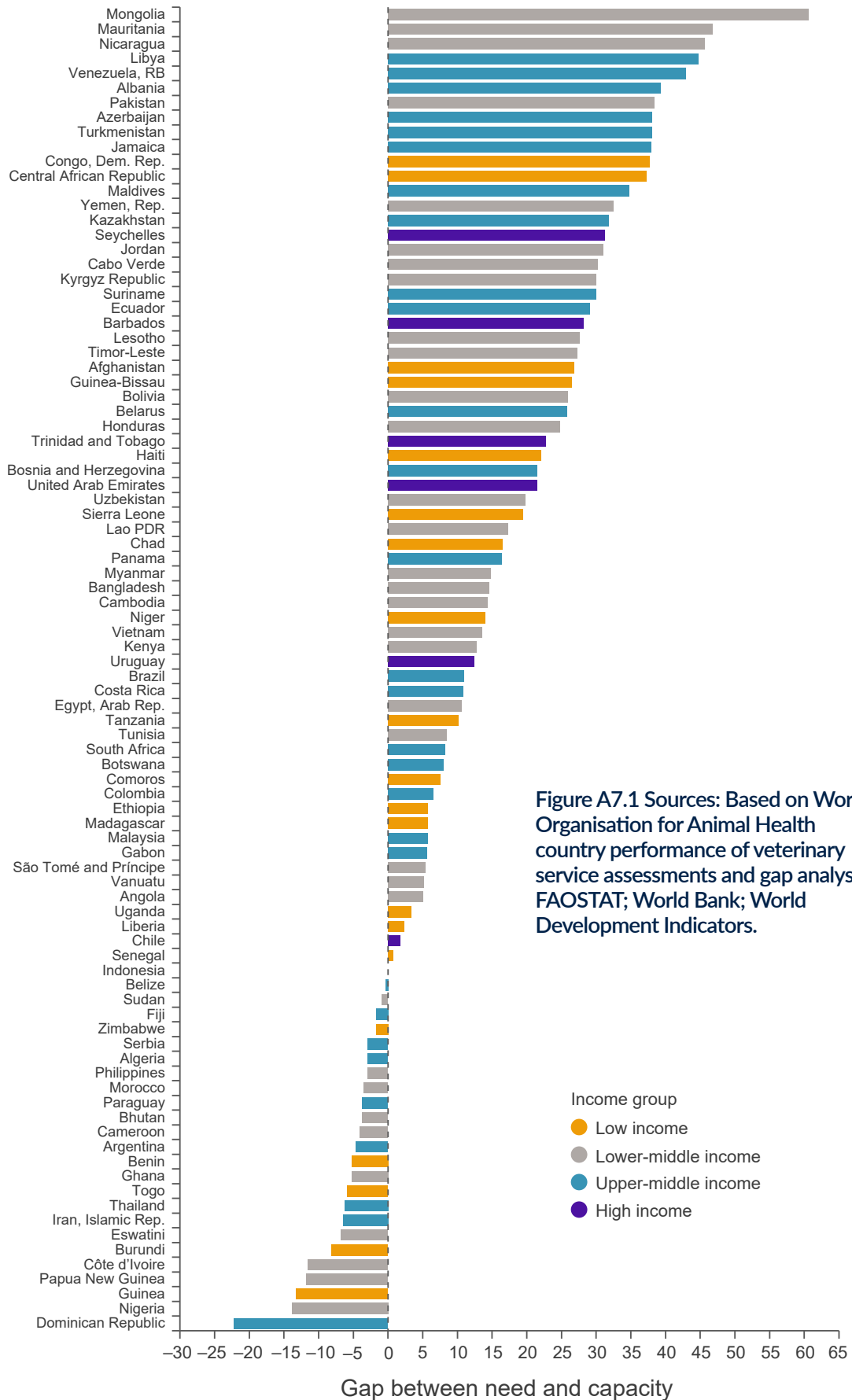


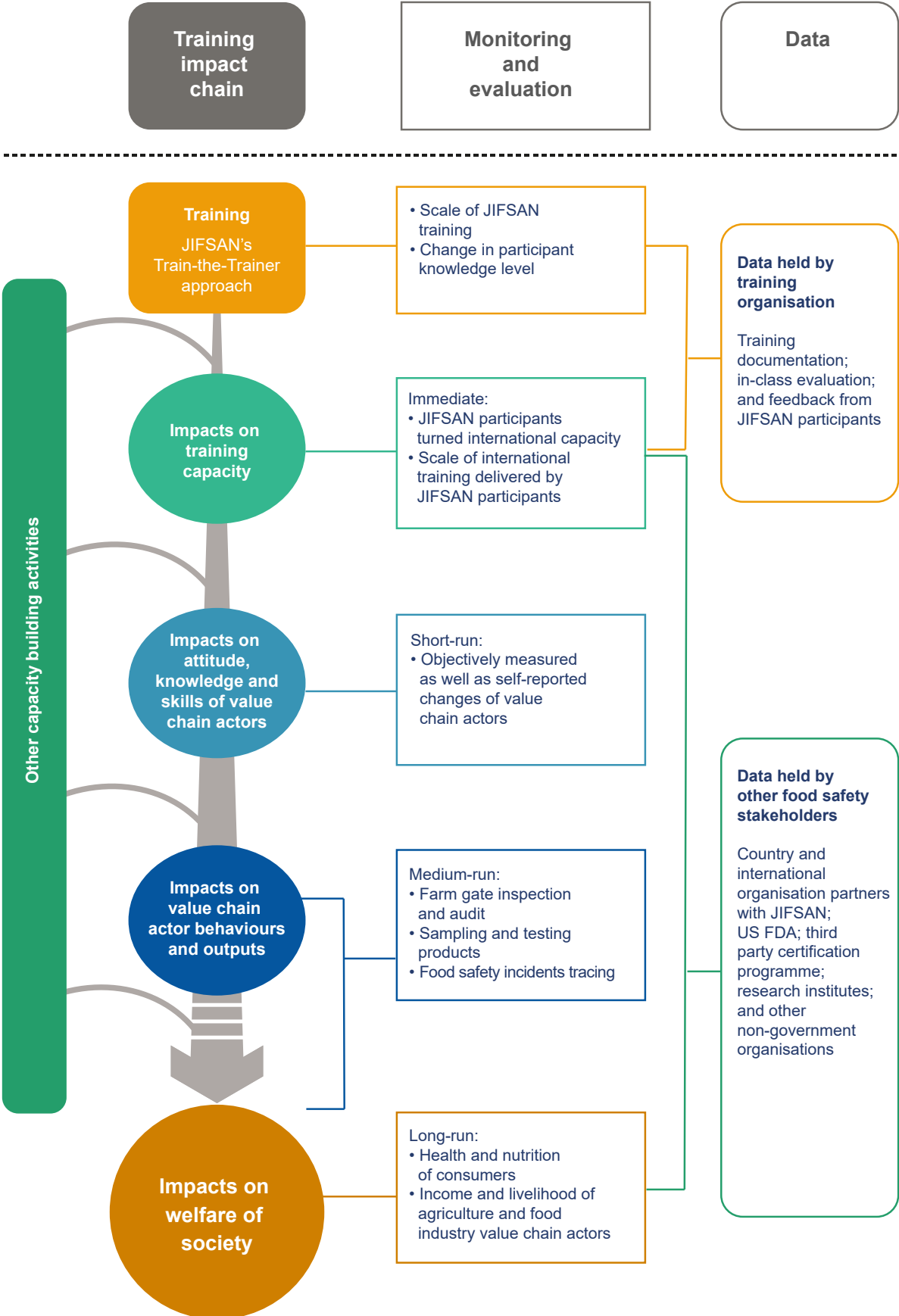
Figure A7.1 Sources: Based on World Organisation for Animal Health country performance of veterinary service assessments and gap analyses; FAOSTAT; World Bank; World Development Indicators.

Annex 8 – Frameworks for food safety measures and metrics in LMICs

| Framework | Standards, measures and metrics | Aim | How it works | Challenges in LMICs | How research can help |
|--------------------------------|---------------------------------|--|--|--|---|
| Foodborne hazards and risks | Public standards | Consumer protection Elimination of fraudulent practices | Hazard analysis Risk analysis | Adopting high income country standards with little adaptation to local context Standards can act as a barrier to market participation Little capacity to enforce standards in informal markets Traceability not a feature | Better adaptation of risk analysis metrics Capacity building in risk analysis Participatory risk analysis |
| | Private standards | Food safety assurance | Hazards and process analysis Risk analysis | Fewer checks and balances as compared to high income countries Little information on use of metrics outside of case studies and research projects Complex risk-based approaches and traceability not readily applicable | Development of measures and metrics to systematically capture the negative externalities of the formal and informal food sectors |
| | Export standards | Consumer protection Food safety assurance Assurance of ethical food production | Trade-related metrics e.g. import rejections | Costs of compliance and verification Complexity of international trade favours exporting high income countries Little information on the value of products rejected or their destination after rejection | Generation of data on health risks of global trade Research into trade flows, behaviour around food consumption and barriers to participation in trade |
| Food safety system performance | Performance indicators | Measurement of how well the food safety system delivers safe food | Benchmarking against defined indicators | Food safety systems suffer from consistent and systemic problems, including inadequate policy and legislation, inappropriate standards and failure to cover the informal sector | Optimising the structure of food safety systems Multi-disciplinary research to bridge the gap between policy/legislation and implementation |
| | League tables | Measurement of food safety performance relative to other countries | Performance against risk indicators | Major deficits in data means that indirect indicators have to be used e.g. Transparency International's ranking as a proxy for risk communication | Develop more robust indicators and ways of capturing data from secondary sources |
| Foodborne disease outcomes | Health outcomes | Surveillance Detection of foodborne disease outbreaks | Reporting by people seeking treatment Calculation of DALYs (disability-adjusted life years) | Under-reporting of outbreaks Assessing the burden of foodborne disease due to manifestations other than gastrointestinal illness DALYs are not easily interpreted | Participatory epidemiology Capacity building in use of DALYs Country studies on foodborne disease health burden |
| | Economic outcomes | Provision of information for rational allocation of resources | Calculation of DALYs Cost of treatment Cost of prevention | Lack of published information on economic costs, cost effectiveness and cost-benefit analysis of interventions to improve food safety in domestic markets | Simplified and comparable methods for assessing economic costs of foodborne diseases Generation of information on costs and cost effectiveness of different options for reducing foodborne disease |

Source [18]

Annex 9 – JIFSAN monitoring and evaluation framework



The impact of skills and education interventions on food safety outcomes

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