FEED THE FUTURE
The U.S. Government's Global Hunger & Food Security Initiative

EatSafe: Evidence and Action Towards Safe, Nutritious Food

Report Recommending Food Safety Additions to the Food Systems Dashboard

Revised July 2022 (Original April 2022)

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This EatSafe report presents evidence that will help engage and empower consumers and market actors to better obtain safe nutritious food. It will be used to design and test consumer-centered food safety interventions in informal markets through the EatSafe program.

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Agreement Officer Representative
Lourdes Martinez Romero

For additional information, please contact:

- Richard Pluke, EatSafe Chief of Party, rpluke@gainhealth.org
- Caroline Smith DeWaal, EatSafe Deputy Chief of Party, cdewaal@gainhealth.org

Global Alliance for Improved Nutrition
1201 Connecticut Ave NW Ste 700B-2
Washington, D.C. 20026

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ACRONYMS AND ABBREVIATIONS

Below is a list of all acronyms and abbreviations used in the report.

AFSI	African Food Safety Index
Codex	Codex Alimentarius Commission (FAO/WHO)
EatSafe	Evidence and Action Towards Safe, Nutritious Food
FAO	Food and Agriculture Organization of the United Nations
FAOLEX	FAO's database of national legislation, policies and bilateral agreements on food, agriculture and natural resources management.
FBD	Foodborne disease
FSCC22000	Food Safety System Certification 22000
GAIN	Global Alliance for Improved Nutrition
GPSI	Government Safety Performance Index
FSD	Food Systems Dashboard
HIC	High-income countries
IHR SPAR	International Health Regulations State Party Assessment Report
INFOSAN	International Food Safety Authorities Network (FAO/WHO)
LIC	Low-income countries
MIC	Middle-income countries
NGO	Non-governmental organization
RASFF	Rapid Alert System for Food and Feed (European Union)
WHO	World Health Organization
WRP	World Risk Poll

EXECUTIVE SUMMARY

Feed the Future's EatSafe: Evidence and Action Toward Safe, Nutritious Food (EatSafe) is a five-year, multi-country program that develops and tests interventions to empower consumers to demand safe, nutritious foods from traditional food markets. Led by the Global Alliance for Improved Nutrition (GAIN), EatSafe consolidates data, knowledge, and evidence from previous food safety interventions and studies conducted in a variety of country contexts – identifying and sharing learnings and best practices for practical application in specific target markets. However, EatSafe has identified a lack of systematic knowledge sharing about food safety and addressing this gap could assist national governments and development agencies to better target food safety resources.

As a leading international nutrition organization, GAIN contributes to knowledge and data sharing activities across many food system topics. This report seeks to identify areas of convergence on food safety indicators relevant to two of GAIN's flagship programs – EatSafe and the Food Systems Dashboard (FSD). The FSD is an online, interactive data portal that acts as a hub for open access food systems data led by a consortium comprised of GAIN and Johns Hopkins University. It illuminates trends related to food systems activities at national, regional, and global levels, using country-level indicators spanning food supply chains, food environments, consumer behavior, and environmental factors.

The FSD aims to provide high-quality, relevant, and action-oriented information to multiple audiences, including country governments and international organizations investing in or managing food systems programs. However, **at present, the FSD does not contain indicators related to food safety, nor are food safety indicators well represented in other food and nutrition dashboards** (e.g., the Global Nutrition Report or the World Bank's Health, Nutrition and Population Dashboard).

Food safety is integral to food systems, both globally and nationally. Introducing food safety indicators into the FSD would advance its objective of reporting accurate and actionable country-scale data that support and track programmatic decisions across food systems dimensions. To address the gap of food safety data within the FSD, this study sought to:

1. Identify and classify indicators relevant to national food safety system functioning;
2. Assess the availability and quality of data sources that could be used to populate the identified indicators in the context of potential inclusion in the FSD; and
3. Develop and illustrate a systematic quantitative scheme to evaluate indicators against FSD's inclusion criteria, to formally evaluate the potential for indicators to be included in the FSD.

As a result of work towards the first two goals, EatSafe identified food safety indicators that could be considered for potential inclusion into the FSD, which include:

1.	Existence of a recall or early warning system	Indicator 1.1
2.	Existence of a system to collect epidemiological data on foodborne disease	Indicator 1.2.a
3.	Foodborne disease burden estimates (regional)	Indicator 1.2.b
4.	Existence of food safety standards (Codex)	Indicator 2.3
5.	Existence of food safety trainings for supply chain actors	Indicator 3.1
6.	Existence of food testing laboratories	Indicator 3.2
7.	Existence of certified businesses according to existing food safety schemas	Indicator 3.3

8. Existence of active consumer associations — Indicator 3.5
9. Consumer perspectives — Indicator 3.6

The recommended indicators cover the main components of food systems: supply chains (including retail), consumers, health outcomes, and selected system drivers (e.g., food safety policy and regulatory environment). Each proposed indicator was evaluated and found to be highly relevant to the FSD Conceptual Framework, as the functions or capabilities captured by these indicators are relevant to assess if national food systems can protect consumers from unsafe food (1).

The third goal of this study aimed to aid future indicator assessments by developing a systematic, semi-quantitative approach to evaluate strengths and weaknesses of candidate indicators for inclusion in the FSD. In Appendix 4, EatSafe describes this approach and applies it to a set of survey questions on consumer perspectives on food safety from the World Risk Poll (WRP), a collaboration between Gallup and Lloyd Register. The selected WRP questions performed well against the FSD inclusion criteria, with six of nine of the indicators reaching or exceeding the target composite score that corresponds to an “suitable for inclusion” evaluation. Aspects of current FSD inclusion criteria that may hinder their applicability to assessing food safety indicators were also highlighted.

Overall, these results represent a key stage within a larger effort to develop or identify key national-scale food safety indicators, and to review global datasets associated with such indicators to assess their suitability for inclusion in the FSD, in the specific, and their suitability to inform programmatic decisions, more in general. Future EatSafe activities to this end are outlined at the end of this report.

1. INTRODUCTION

A primary objective of Feed the Future's EatSafe: Evidence and Action Toward Safe, Nutritious Food (EatSafe) is to consolidate and generate knowledge and evidence about consumer values and behaviors related to food safety. EatSafe and the Food Systems Dashboard (FSD) are both consortium programs led by the Global Alliance for Improved Nutrition (GAIN) that seek to share food and nutrition knowledge and data. The FSD is an online interactive platform for visualizing and connecting disparate components of national, regional, and global food systems. Presently, the FSD includes over 160 unique indicators from approximately 20 data sources – including large, open access datasets from the Food and Agriculture Organization (FAO) of the United Nations and World Health Organization (WHO). Metadata contextualizes each indicator within the FSD Conceptual Framework (1).

Developed to assist policymakers, researchers, and development organizations, the FSD tracks food systems indicators related to the United Nations Sustainable Development Goals. The FSD captures country-level indicators across four key areas: food supply chains, food environments, consumer behavior, and external drivers. It is a valuable tool to examine trends across both time and geography. New indicators are integrated into the FSD on an ad hoc basis, with candidate indicators screened using a set of agreed-upon inclusion criteria (Appendix 1) as well as an expert review. At present, the FSD Conceptual Framework does not include any food safety-related indicators and it is unclear whether the scope of the FSD Conceptual Framework is sufficiently broad to include food safety-related indicators.

Though missing from the FSD, food safety is an integral part of food systems (**Figure 1**). Effective food safety programs map to all components of food systems, such as the structures and actions that allow the food produced and consumed in a country to be safe. In other words, one component of a food system (e.g., supply chains), cannot be effective if it doesn't include ways to manage food safety both within that component and in its links with other components (e.g., how policy or training options affect supply chains).

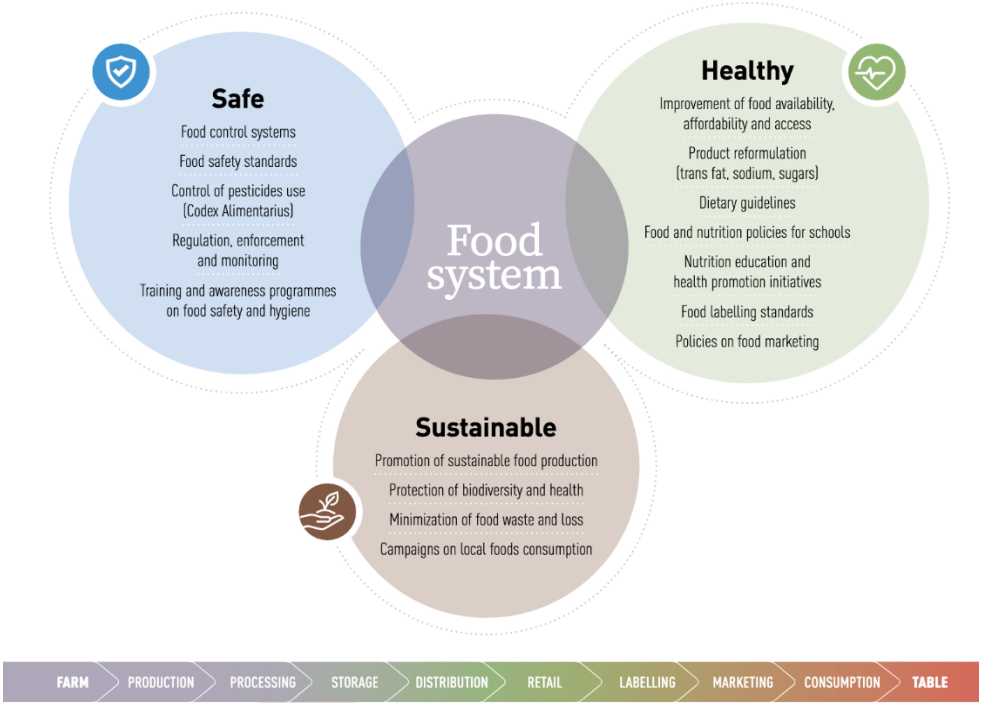


Figure 1. *Schematic View of a Food System, From Farm to Table (Source: WHO) (2)*

Adding food safety indicators to the FSD would enable it to better fulfill its goals because food safety represents a key element of effective food systems (i.e., food must be safe to be considered food). In addition, raising the visibility of food safety among stakeholders in other domains and highlighting action-oriented indicators of a country's food safety system would enhance the quality and effectiveness of programmatic insights provided by the FSD.

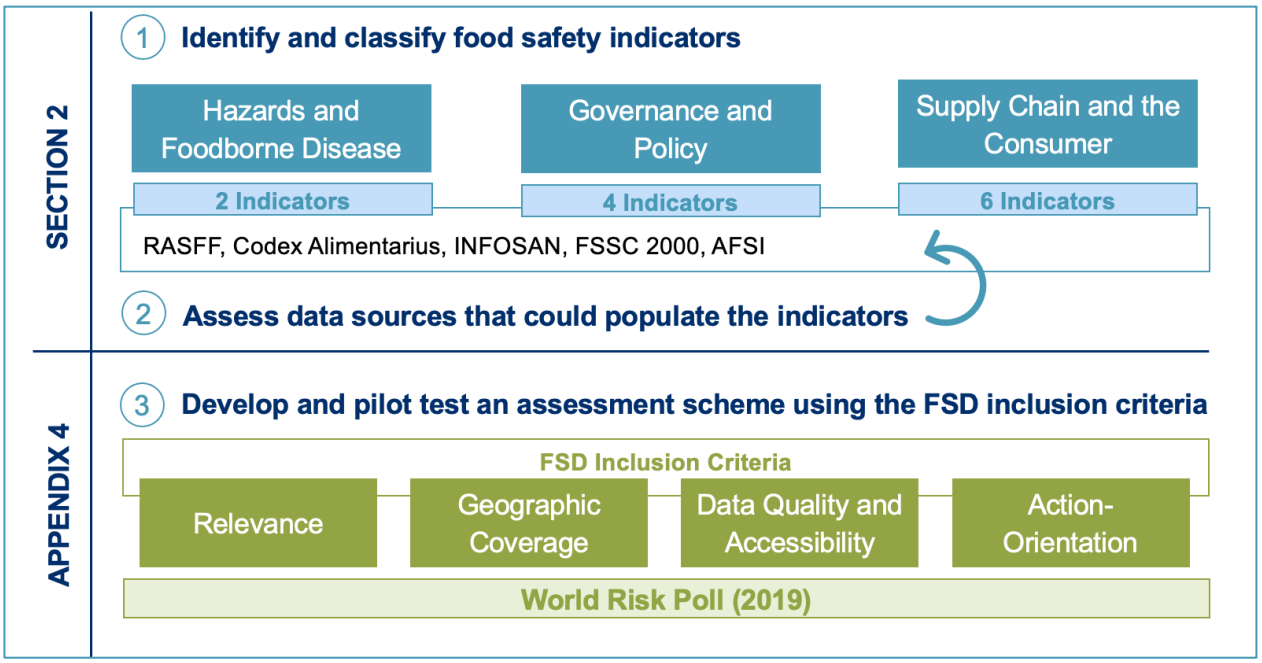
1.1. OBJECTIVES AND REPORT STRUCTURE

The goals of this study were to:

1. Identify and classify indicators relevant to national food safety system functioning;
2. Assess the availability and quality of data sources that could be used to populate the identified indicators; and
3. Develop and test a systematic quantitative indicator assessment scheme based on the FSD's inclusion criteria to formally evaluate their potential inclusion in the FSD.

As shown in **Figure 2,** the first two goals are presented in Section 2, the third in Appendix 4.

Figure 2. *Objectives and Report Structure*



2. REVIEW OF THE FOOD SAFETY INDICATOR DATA LANDSCAPE

As part of its global scope, EatSafe contributes to the development of food safety indicators to identify areas of strength and weakness in food safety systems at a global, regional, and national scales. For this purpose, EatSafe undertook a review of selected food safety indicators and associated data sources to assess whether data exist and are suitable to populate the indicators in a way that meets criteria for inclusion in the FSD. The selection of indicators to include in this review and their classification was based upon previous work conducted by EatSafe (3), as well as an initial data search conducted as part of this study.

Food safety is captured by many different activities managed by private sector, the public sector and consumers. Examples of private sector activities include all actions that aim to ensure food safety through the supply chain, from production to processing, transportation, storage, and retail. Public sector activities include functions such as enacting policy and legislation, food safety inspection and enforcement in the supply chain, ability to assess hazard occurrence, respond to outbreaks, and measure health outcomes i.e., foodborne disease (FBD) burden. Consumer activities include individual actions such as purchasing choices, home food preparation practices, engagement with civil society organizations, reviewing a restaurant online, or asking questions to food vendors, as well as collective actions such as consumer associations' advocacy or class actions. Some functions may be shared by multiple actors; for example, standards may be required – with different degrees of discretionarily and consequences – by the government but also by the industry actor that a company supplies their product to (e.g., lettuce producers need to meet the standards of aggregator and processing companies).

2.1. METHODS: INDICATOR SELECTION AND CLASSIFICATION

EatSafe identified indicator domains ("domain" is here defined as the collection of potential indicators related to a topic or function) that capture different food system structures and functions that enable food safety action at the country level. These domains can also be mapped to food systems components (1,4): supply chains, food environments, consumers, outcomes, and aspects of the enabling environment (see Appendix 2). For the purposes of this review, we grouped indicators in three categories (**Figure 2**):

- **Hazards and Foodborne Diseases Burden** covers indicators related to the ability to measure the burden of foodborne diseases (i.e., epidemiological and attribution data), for either preventive or response purposes; the occurrence of foodborne hazards at various stages of the supply chain; and the availability of national or regional food recall or horizon scanning platforms that enable timely action or information sharing. This category represents the public health readiness and proactiveness that is essential in a food-safe ecosystem. Of the candidate indicators, EatSafe determined data availability about national or regional recalls very promising during a preliminary review. This information can be obtained from country-specific data sources and from international organizations compiling data such as WHO and the European Union's Rapid Alert System for Food and Feed (RASFF; (5).
- **Governance and Policy** captures the regulatory enabling environment at the national or regional level, ranging from competent national food safety authorities to national legislation and standards. Indicators included in this category represent country-specific capacities such as producing and enacting regulations. Data

availability was assessed using the websites of national or regional food safety agencies in areas such as legislation, food safety policy and regulation, inspections, standards and education. Other sources included countries' membership in international food safety authorities such as the Codex Alimentarius Commission (Codex; (6) or the International Food Safety Authorities Network (INFOSAN; (7), both of which are managed jointly by the WHO and FAO – as well as individual documents from the WHO and FAO, and the FAOLEX Database (8–11).

- **Supply Chains and Consumers** includes indicators covering supply chain standards, food business certification, and availability of training for food businesses. This category emphasizes industry-developed standards (e.g., Food Safety System Certification (FSCC22000) (12) or the Global GAP (13)), food safety certification bodies, and food testing infrastructure. Consumer related indicators (e.g., presence of consumer associations or civil society organizations) are also included here, as part of the demand side of the supply chain. Insights on consumer behavior and attitudes, a novel domain, were derived from the Lloyd's Register Foundation World Risk Poll (14) whose global data was analyzed in Appendix 4 to illustrate a proposed indicator scoring scheme.

2.2. METHODS: REVIEW PROCESS

The process used to review national-scale food safety indicators and associated data included the following steps:

- Within the three categories outlined above, EatSafe first defined a set of preliminary indicators.
- EatSafe reviewed the availability and quality of data to support each preliminary indicator in broad terms, conducting a global data search at both individual country and multi-country levels to identify key data sources that could be used to populate a given indicator or its domain area.
- EatSafe categorized individual countries into three groups: low-, middle-, and high-income countries (LIC, MIC, and HIC, respectively). EatSafe also focused on identifying data availability for the 20 Feed the Future target countries.[1]
- If EatSafe determined that a sufficient amount of high-quality data was available, the indicator was retained, refined as needed to match the supporting data, and further assessed using a qualitative approach based on broad FSD inclusion criteria categories covering both indicator attributes (relevance and action-orientation of the indicator) and data attributes (geographic coverage, quality, accessibility, and timeliness) (see Appendix 1 for the complete list of FSD inclusion criteria).
- A recommendation on further consideration for inclusion in the FSD was reached for each indicator based on indicator and/or data attributes. Other indicators where supporting data were found to be insufficient are either not presented here or qualitatively discussed as part of the domain of the reviewed indicators, but not assessed independently.

2.3. RESULTS: REVIEW BY INDICATOR

This section presents results of the first two goals of the study. The definition of the 12 indicators included in this review, and the rationale for including them, are shown in **Table 1**.

[1] This includes the existing 12 Feed the Future countries and the eight new countries added in June 2022.

In the sections that follow, EatSafe discusses each indicator ultimately recommended as priority for potential FSD inclusion (highlighted in light blue in **Table 1**). Recommended indicators were selected based on indicator attributes (e.g., importance of the indicator within food safety systems and relevance to the food system framework, usefulness in assessing a country's status, and action-orientation i.e., usefulness in prioritizing interventions) and/or data attributes (availability of data of adequate geographical coverage across and within countries, quality, accessibility, and how recent or frequently updated the data are). These criteria were applied qualitatively in the review of the indicators' data landscape (Section 2).

Indicators not prioritized for inclusion in the FSD at this time, as not yet mature or requiring more effort to be defined or populated, are described in Appendix 3 (and not highlighted in light blue in **Table 1**). Specifically, two indicators, while relevant, were considered as lower priority for FSD inclusion due to potential redundancy or correlation with other indicators: Indicator 2.1 – Existence of a governmental food safety agency or authority and Indicator 2.4 – Existence of a food safety inspection system. Indicator 2.2 – Existence of food safety policy and law was deemed to require further definition to be viable. Indicator 3.4 – Food traceability in export and domestic markets while relevant, was deemed not suitable for FSD inclusion due to its lower applicability in LICs and MICs, as well as its focus on export markets.

In addition, this study's third goal – to develop and test a systematic quantitative indicator assessment scheme customized to the FSD – is illustrated in Appendix 4. Further steps to advance the inclusion of food safety indicators in the FSD, as well as allied activities, are discussed in Section 3 ("Future Work") of this report.

Table 1. *Indicators Included in the Food Safety Data Landscape Analysis*

#	INDICATOR [1]	CHARACTERISTICS AND RATIONALE
HAZARDS AND FOODBORNE DISEASE BURDEN		
1.1	Existence of national or regional food recall alert, early warning, and/or horizon scanning system	The availability of surveillance and investigation systems for food safety related hazards indicates the level of food safety proactiveness within a national or regional food system.
1.2	Epidemiological data collection on foodborne burden (FBD)	The existence of a mechanism to collect and report public health data specifically related to FBD occurrence is key to assess the needs and effectiveness of food safety programs. Two indicators were prioritized within this domain: 1.2.a (Existence of a system to collect epidemiological data on FBD) and 1.2.b (FBD estimates).
GOVERNANCE AND POLICY		
2.1	Existence of governmental food safety agency or authority	The presence of an agency at the national level help facilitate the safety and health of food, acting as a single point of reference for food control management, communication, and coordination.
2.2	Existence of food safety policy and law	Enabling policy and law is a prerequisite for the establishment and organization of national and local food safety systems.
2.3	Existence of food safety standards (national or codex)	An active national Codex committee and/or well-established food safety standard can facilitate transparent information exchange, food trade, and protection of consumers' health.
2.4	Existence of food safety inspection system (private or public)	Food safety inspection bodies enforce food safety standards across the supply chain and especially food manufacturers, retailers, and restaurants.
SUPPLY CHAIN AND CONSUMERS		
3.1	Existence of recognized food safety trainings for supply chain actors	Training indicates increased levels of awareness and skills across the supply chain, key to the ability to implement best practices or, for consumers, to recognize and demand them.
3.2	Existence of food testing laboratories	Food monitoring laboratories allow a continuous examination of food and clinical specimens for a wide variety of hazards. Private or public labs are essential for maintaining high standards of food safety control.
3.3	Existence of certified businesses according to existing food safety schemas	Foods that are certified are recognized everywhere, thus food manufacturers bearing highly respected global standards.
3.4	Food traceability in export and domestic markets	The presence of a traceability system not only for export purposes but also for the domestic market indicates a high level of public and private food safety standards and transparency.
3.5	Existence of active consumer associations	Consumers associations and NGOs play an instrumental role in the communication and dissemination of food safety practices for the protection of their health and interests.
3.6	Consumer perspectives	A collection of survey questions reflecting consumers' opinion on risk perception, perceived FBD burden, trusted sources of food safety information, and attribution of responsibility on food safety.

[1] Rows with a light blue shade indicate indicators that are recommended for further consideration for inclusion in the FSD at the time of this review.

2.3.1. HAZARDS AND FOODBORNE DISEASE OCCURRENCE

Existence of national or regional food recall alert, early warning, or horizon scanning system (Indicator 1.1)

Food recall alerts and early warning systems are commonly used by national governments. They are essential to public health as they are used to warn consumers and remove contaminated products from commerce. In terms of indicator relevance to food systems and action-orientation, this attribute of food safety systems allows governments to take action to prevent and respond to the detection of food safety threats in the supply chain before consumers are exposed. The existence of a functioning recall/early warning system is an important indicator to determine if a food system is operating to protect the public from unsafe food. The absence of a recall system or major weaknesses in that mechanism (e.g., recalls are not posted publicly) would provide a strong signal that a country's food safety system is not protecting consumers from unsafe food and prevent illness.

The main data sources for this indicator were Codex Alimentarius member profiles (6) and food safety authorities of individual countries. Examples of horizon scanning systems can be seen at a local (state or country level, e.g., Turkey's Food Safety Information System (15)) or regional level (e.g. the European Union's RASFF of (5). While all HIC have a functioning food recall or horizon scanning system, the majority of LICs and MICs do not have an early warning mechanism in place for informing food system actors on potential threats. Some countries have warning systems and associated data sharing mechanisms, but they are not updated frequently (e.g., the Bolivia's Rapid Alert Network Information System (16) which was not updated during 2021). Generally, if a country has a functioning recall system, the associated data are posted publicly. Hence, the availability and update frequency of recall data can provide an indication of whether the recall system is operational. Data published on national web portals usually support accessibility through a machine-readable format (e.g., RSS or API); however, since most of the countries do not support such portals, the majority of the data – when available – is only accessible in HTML format.

Codex Alimentarius country profiles are a valuable data source for several indicators reviewed in this report (6). The Codex Alimentarius body of standards and guidelines (17) provides guidance on food safety principles, risk assessment and management approaches, and standards for specific foods. In addition, the Codex Commission also provides capacity building to allow member countries to participate in standard setting activities. The 188 current Codex member countries (out of a total number of world countries of 217), plus one member organization, the European Union, work with Codex to align their national policy and improve their national food safety system. Codex Country Profiles provide a summary of the status of select components of a country's food safety system, including: Competent authorities; laws and regulations; the national Codex programme; Risk assessment and scientific data (including basic information on official national laboratories); Surveillance of foodborne diseases and monitoring of food contamination (6). An example of a Codex country profile is Nigeria.

Globally, the International Health Regulations (IHR; 2005) State Party Assessment Report (SPAR) established a national-scale monitoring framework that includes food safety and zoonotic events (18). IHR SPAR includes an indicator of early warning function (C6.1) and one on mechanisms for event management (C6.2), i.e. outbreak investigation and analysis. The

Food Safety indicator, the only IHR SPAR indicator specific to food safety (C4.1), tracks the degree of a nation's participation in the international FAO/WHO INFOSAN network (7) to report foodborne outbreaks of international significance and improve food safety emergency management. In addition, the section on National Health Emergency Framework (C8) includes outbreak response capabilities. Most indicators, including many relevant to the set of indicator domains in this report, cover health system functions across a wide range of hazards, including but not limited to foodborne. A key feature of this dataset is that indicators are scored on a scale of 5 levels representing different well-defined degrees of development and operational capacity.

Data are available for an increasing number of countries since 2010, with an 88% submission rate in 2019. Annual updates are expected in the future. Data are aggregated into one database (19) and can also be visualized in aggregated format in a custom dashboard (20). While self-reported, this dataset has wide global coverage and is collected using the same tool (21). The existence of a custom dashboard can facilitate automated data extraction and processing.

At the time of this review, based on the data sources outlined above, the following insights could be drawn on this indicator:

- While the Codex country profile dataset has ample geographic coverage across income groups, including 7 of the 20 Feed the Future target countries, not all country profiles are available. Also, information is available as text, in multiple languages, which would require processing to populate an indicator.
- An indicator on the existence of a recall or early warning system is valuable on its own, as it could help identify whether this component of a national food safety system needs efforts to be established, individually and relatively to other system components (this is true for several indicators covered in the following sections); however, as a yes/no variable this indicator does not provide more nuanced information on the level of development of a recall system, or what obstacles may be hindering its full functioning; as such, knowledge of the existence of such a system may not suffice to support investment decisions.
- At global level, the recently developed WHO IHR SPAR indicators provide a self-reported assessment of the development status of early warning and outbreak detection and response capabilities in a wide range of countries, albeit not specific to foodborne events.

Epidemiological data collection on foodborne disease burden (Indicator 1.2)

The existence of a reporting mechanism for public health data is key to measuring the burden of FBD in countries and provides a feedback mechanism for national and private-sector food safety programs. Reliable FBD burden estimates are the gold standard, as such estimates provide clear evidence on both the need for food safety interventions, and the effectiveness of the national food safety system in controlling disease. When attributed to specific foods and hazards, FBD burden data also support the prioritization of interventions. Hence, in terms of relevance to the FSD conceptual framework and action-orientation, indicators in this domain are of high priority.

Within the domain of epidemiological surveillance, EatSafe investigated available information on the epidemiological data collection and reporting system itself (existence of a surveillance system, Indicator 1.2.a), while also considering the FBD burden data produced by such system (Indicator 1.2.b). Information on the existence of national surveillance system were derived from

Codex country profiles (6), or individual countries' health agencies, when country profiles were insufficient. For FBD burden data, source vary in data availability, quality, and accessibility. Some national authorities may publish annual reports summarizing collected data, or data is reported to the WHO Foodborne Disease Burden Epidemiology Reference Group, an ongoing effort to estimate the global FBD burden (22). However, efforts to estimate FBD burden at global level is very recent, with the first estimates being published in 2015 using 2010 data.

In African Union countries, recently developed food safety indicators within the African Food Safety Index (AFSI) – specifically the Food Safety Health Indicator and three of its sub-indicators of health burden (i.e., incidence of foodborne-related diarrhea, child mortality, and liver cancer) – are expected to track selected foodborne burden in this region (23) (24).

The other two AFSI indicator categories besides health are food safety systems and Food Trade. Sub-indicators within the Food Safety Systems Indicator relevant to this category include a rating of the national database of FBD and of the national FBD response system. The AFSI indicators are part of a wider initiative (Comprehensive Africa Agriculture Development Programme) to track progress in agriculture (25). Data collection has started, with a baseline in 2015 and a target of 2025 for the next data collection wave. While these are not global indicators, they exemplify a strong regional initiative to track regionally-relevant indicators across several countries.

Main insights related to the domain of epidemiological surveillance (including both the system that collects and process epidemiological data, and the FBD burden data themselves) include:

- For the majority of world countries, including 5 of the 20 Feed the Future target countries, information exists and can be obtained on the existence of a national surveillance system (as a yes/no variable); so, while data may generally be available, it is often in individual health agency's sites and may not be machine readable.
- Some countries have ongoing efforts to develop capacities for epidemiological surveillance. While some approaches for rating national surveillance systems have been proposed (26,27), they are not widely used. Hence, the inclusion of an indicator of surveillance system based on performance does not seem possible at this time.
- Recent estimates of FBD burden exist and are available. It is anticipated that they will be updated soon. These data are highly relevant for the FSD as a key indicator of the food safety status of a country. However, they are currently not computed by country, but only by subregion. While extrapolation to individual country is possible, it would require further calculations. In addition, this indicator is often politically sensitive for a country, hence inclusion of regional estimates may be more appropriate.
- New indicators such as the Food Safety Health burden section of the African Food Safety Index (AFSI) are expected to provide additional information in this region, in the near future.

2.3.2. GOVERNANCE AND POLICY

Existence of food safety standards (national or Codex) (Indicator 2.3)

An active national Codex committee and/or well-established food safety standards can facilitate transparent information exchange, food trade, and protection of consumers' health. Based on a

preliminary analysis, almost all countries had data available on existing food safety standards. In particular, countries that are members of the Codex Alimentarius Commission are included in Codex databases (6), which allows to access data on a large number of countries in one fairly uniform database. In Codex member countries, national food safety standards committees are considering Codex standards for adoption as national food safety standards, unless other standards are developed that apply to both domestic and exported supply chains. For example, Cambodia's National Codex Committee consists of representatives from relevant ministries that directs national food safety policy and implementation (28). Some Codex member countries have national food safety standards linked to Codex, so their standards are updated at similar intervals as those of Codex (i.e., approximately every five years) (29). In terms of indicator attributes, this indicator complements the previous one. It is particularly relevant for countries that lack a national food safety policy to adopt Codex standards and guidance, as they provide internationally harmonized objectives and guidelines for national governments to implement.

Codex provides the most comprehensive set of international standards on food safety designed to be broadly applicable in LICs and MICs (30). While not intended as a substitute for national legislation, Codex guidelines provide a blueprint that can be voluntarily adopted by countries that have not yet developed their own food safety policy or legislation, as a starting point to build upon based on the specific national context. The standards and guidelines are developed at Committee meetings that include national governments and observers, using a consensus-building process. Codex is comprised of General Standards Committees (e.g., Codex Committee on Food Additives; Codex Committee on Food Hygiene) and Commodity Committees (e.g., Codex Committee on Fresh Fruits and Vegetables; Codex Committee on Fats and Oils). These Committees develop standards of quality and safety for a broad range of food products (30). All Codex texts (standards, guidelines, and codes of practice) are voluntary, and must be included into national legislation to be enforceable.

Main insights related to this domain include:

- For nearly all countries, including all 20 of the Feed the Future target countries, information exists and can be easily obtained on the adoption of Codex standards (as a yes/no variable), as well as a country's membership in Codex; this information can be found in the Codex country profiles and membership rooster. It is updated periodically after a country achieves membership.
- The vast majority of countries (188 out of 217) are Codex members, which implies that they either have adopted or are in dialogue about adopting Codex standards. Hence, while informative, this indicator may allow for limited comparisons across countries and may be most useful to evaluate the minority of countries that are not aligned with Codex standards.
- National standards in addition or in alternative to Codex standards exist in several countries (e.g., all HIC). However, these data are complex, comprising a broad range of hazards, commodities, testing methods, etc. relevant to individual countries, and currently not well summarized. Hence, indicators based on national standards separate from Codex, while informative, are not recommended for inclusion in the FSD at this time due to the effort needed to review individual country data.
- An indicator based on Codex standards adoption is recommended for further consideration due the central role of Codex for many LICs and MICs.

2.3.3. SUPPLY CHAIN AND CONSUMERS

Existence of food safety trainings for supply chain actors (Indicator 3.1)

Food safety training and education is instrumental for ensuring that all food supply chain actors – including the private and public sector, as well as consumers – are informed about good food safety practices. Although capacity building opportunities are key to consistent implementation of good food safety practices, data was less available for this indicator, as no organized databases on training were identified. In terms of indicator Relevance and Action-Orientation, this indicator can be seen as relevant to both supply chains, and the enabling environment. The availability of food safety management trainings for businesses (as well as for consumers) is a necessary function to enable food businesses to improve their practices and meet food safety standards and is most often conducted by the private sector industry. Existence of standards and even enforcement without a way to guide those businesses towards improvement is likely ineffective, which makes training essential.

Training resources are available through large international associations such as Global Food Safety Resource (31) and Global Food Safety Partnership (32), research institutes, national authorities, and international organizations. Many countries leverage local Codex committees to organize trainings for local stakeholders from both the public and private sectors (e.g., Benin (33)). In the Dominican Republic, for instance, the organization Inter-American Institute for Cooperation on Agriculture (34) organizes trainings on specific topics (e.g., requirements for foods coming to the U.S. under the U.S. Food Safety Modernization Act (35).

Main insights related to this domain include:

- Indicators representing the availability of food safety training for food businesses are highly relevant and action oriented.
- Data in this domain exist but is limited or not always readily accessible. For instance, in the surveyed databases, data was available only for 55% of MIC, and only for 12 of the 20 Feed the Future target countries.
- Two key data sources with large global coverage were identified, the Global Food Safety Resource (31) and Global Food Safety Partnership (32). These sources offer large geographical coverage and uniformity of data tracking and sharing. However, they do not cover training programs offered by national or local governments.
- Consumer-facing trainings or educational campaigns were not covered as part of this review, as a preliminary data search revealed a highly heterogenous landscape; they are, however, related to Indicator 3.5 – Existence of active consumer associations, as well as the focus of a separate EatSafe review (36), and could be considered in future indicator assessments.
- Although data coverage and accessibility hurdles exist, and while inclusion of an indicator on the existence (yes/no) of any training capabilities in a country into the FSD may be of limited use without more detailed data, this indicator (and the domain of training availability more in general) is recommended for further investigation due to its cross-domain and central role in enabling effective food safety controls. Additional data sources may also exist, that were not uncovered in the present review.

Existence of food testing laboratories (Indicator 3.2)

The ability of a country to test for a range of foodborne hazards is critical to multiple aspects of food safety systems: assessing the problem and responding to disease outbreaks (in conjunction with a food recall, early warning, or horizon scanning systems, as represented by Indicator 1.1), ensuring adherence to standards (e.g. as part of an inspection system, see Indicator 2.4), and to measure disease burden, i.e. assessing the effectiveness of a food safety system in achieving its primary goal (see Indicator 1.2 – Epidemiological data collection on foodborne burden). As such, the existence of laboratory structures and capabilities –as well as the number of laboratories and their analytical capabilities– is a strong indicator of the ability of other food safety functions to operate.

Data for this indicator are highly heterogeneous, posing issues of accessibility and harmonization. Regional laboratory associations (e.g., Red Analitica de Latino America y El Caribe (37) and the African Food Safety Network (38)) provided useful data that have collated the laboratory capacity in country. Several ongoing international initiatives supported by the European Union, WHO, or other private entities focus on the development of food testing laboratories in African countries (e.g. Turkmenistan (39) or Uzbekistan (40), the latter of which combines lab development with laboratory training). In addition to government-affiliated laboratories, listed in Codex country profiles where available, private sectors laboratories can also play an important role. In the review, the websites of multinational food safety testing companies were also accessed (41–43) to determine coverage level of countries, when no official government of Codex sources were available.

Main insights related to this domain include:

- Indicators representing the availability of food testing infrastructure are highly relevant and action oriented.
- Data on laboratory capabilities (extent, scope, functionality) is heterogeneous and can be found in either Codex country profiles (included in the section on “Risk assessment and scientific data” providers), large multi-national laboratory companies, or regional laboratory associations. While this information is relevant and valuable, its de novo compilation and harmonization would be resource intensive.
- No existing multi-country assessment of food safety testing capabilities was identified.
- For MIC, 69% (79 out of 110 countries) have data available, including 18 of the 20 Feed the Future countries.
- While inclusion of an indicator on the existence (yes/no) of any laboratory capabilities in a country into the FSD may be of limited use without more detailed data (e.g., ability to test against existing standards), this indicator is recommended for further investigation due to its central role in verifying and enforcing food safety controls.

Existence of certified businesses according to existing food safety schemas (Indic. 3.3)

Certification systems for food businesses likely reflect international trade activities, as private businesses increasingly request food safety certification to compete on the export market of high-value commodities. Because this indicator frequently does not cover certification of food businesses targeting consumers in domestic markets, further analysis is necessary to bring this

indicator to this higher level of detail. In terms of indicator attributes, this is an advanced indicator that primarily applies to the formal sector. Certification schemas (public or private) complement other food safety functions (e.g., national standards, and aspects included in inspections), and can be useful in representing how active domestic or export businesses are in seeking improvements, in particular when certifications are voluntary. However, this indicator may be biased by the presence of an export market, subject to foreign or private standards, and not be representative of food safety in domestic supply chains.

Two large global and well-known data sources were identified and leveraged in this review, which are food safety standard-setting organizations working respectively on food manufacturing (12) and agricultural food products (13). All MIC are included in the databases of either or both these organizations. Broadly, these databases include registries of individual businesses, which commodities they produce or process, and on which standard they are currently certified. Most businesses are likely exporters, but the registry does not provide this information. Other certifications exist but were not reviewed in detail.

Main insights related to this domain include:

- Indicators representing the adoption of internationally recognized food safety certifications by food businesses in a country are highly relevant and action oriented.
- Data are available and accessible from the most widely adopted and recognized schema, namely Global GAP or FSCC 22000. These databases include all but one of the 20 Feed the Future countries.
- However, it is not straightforward to distinguish export from domestic markets, and large food companies that can afford certification are more likely to be exporters.
- Due to the relatively high data availability, and the fact that this indicator domain represents private sector initiatives (not visible in several other indicators that focus on government capabilities), this indicator is recommended for further consideration.

Existence of active consumer associations (Indicator 3.5)

Consumers are also an integral part of domestic supply chains as well as governance structures, which consumers can shape. In terms of indicator relevance and action-orientation, this indicator, as well as the next one, add a focus on the role of consumers not just as consumers of food, but also as actors that can shape food systems. The existence (or the degree of activity) of consumer organizations in a country could signal strong demand and willingness to act towards improving food systems; this information is key to design programs that involve or rely on consumer demand.

The data landscape in this domain is, as expected, varied. Some countries have multiple consumer associations (e.g., Brazil), while others have active associations despite lacking a food safety authority (see Indicator 2.1; e.g., Lesotho) (44). Consumers International was the main global data source identified, reflecting its large geographical coverage and uniformity in data format. Consumers International brings together over 200 member organizations in more than 100 countries across all income groups. At the level of detail afforded by this data source, an indicator could track the existence or number of consumer associations over time in a

country, but not (or not easily) the size of its membership, level of consumer engagement, or level of advocacy activity specific to food safety issues.

Main insights related to this domain include:

- Consumer International is a prime resource for data on consumer organizations worldwide; other data sources exist, but not as comprehensive or easily accessible.
- Data on the existence of consumer organizations is available for most countries, including 13 of the 20 Feed the Future target countries.
- The existence or number of consumer organizations in a country can be a useful indicator suggestive of the importance and role of consumers' collective voice in shaping food safety demand and the food safety system. Their role may also be relevant to other food system components within the FSD scope, such as fostering consumer demand and advocacy for improved nutrition.
- However, information on the specific role, action, or effectiveness of consumer organizations in each country (including how much they work on food safety specifically) is not readily available or accessible. Hence, a more nuanced indicator does not appear viable at the time of this review.
- Due to the central role of consumers and consumer advocacy organization in improving food safety, as well as nutrition and other aspects of food systems, this domain is recommended for further investigation, and an indicator on the existence of active consumer organizations is recommended for potential inclusion in the FSD.

Consumer perspectives (Indicator 3.6).

Consumer perspective indicators provide an innovative approach that does not rely on government data collection and reporting. An example of indicators covering consumer perspectives on food safety comes from the World Risk Poll (WRP) (14). The specific WRP survey questions relevant to food safety, as well as the proposed indicator assessment scheme, are shown in Appendix 4. Using a transparent and reliable methodology, the WRP includes data from 142 countries, including remote regions not usually included in data collection efforts. While the WRP data collection effort may be time limited – the first survey was conducted in 2019, and will be repeated four times, every two years until 2025 – the data will be current for at least the next decade. Data are openly available in easily machine-readable formats.

In terms of indicator attributes, this is a novel indicator area, that would highlight the importance of consumer perceptions and attitudes in shaping demand and advocacy for food system changes that can improve food safety. Each question within the food safety-relevant section of the WRP can be thought of as an individual indicator. Data on individual WRP survey questions is collected within the same survey conducted uniformly in all participating countries.

Main insights related to this domain include:

- Consumer perspectives derived from direct consumer polls are a novel class of indicators that can highlight the key role of consumers in food systems, consistently with the emphasis placed on consumers and food environments in the FSD conceptual framework.

- The Lloyd's World Risk Poll provides a high-coverage global poll in 142 countries, conducted with uniform and transparent methodology. Data are current, but the extent of future availability of these data beyond the next 5 years is uncertain.

3. FUTURE WORK

Based on this assessment of data availability, quality, and accessibility of a broad range of indicator domains relevant to food safety, as well as consideration of how different stakeholders may use these indicators in assessing gaps and tracking progress, EatSafe recommends the following nine indicators as a priority for selection and preparation for inclusion in the FSD:

1.	Existence of a recall or early warning system	Indicator 1.1
2.	Existence of a system to collect epidemiological data on foodborne disease	Indicator 1.2.a
3.	Foodborne disease burden estimates (regional)	Indicator 1.2.b
4.	Existence of food safety standards (Codex)	Indicator 2.3
5.	Existence of food safety trainings for supply chain actors	Indicator 3.1
6.	Existence of food testing laboratories	Indicator 3.2
7.	Existence of certified businesses according to existing food safety schemas	Indicator 3.3
8.	Existence of active consumer associations	Indicator 3.5
9.	Consumer perspectives	Indicator 3.6

For inclusion in the FSD, EatSafe recommends the following next steps to evaluate evaluation the recommended indicators:

- Discuss the findings of this review with the FSD team (in progress) and other stakeholders.
- Extract and compile data related to each indicator; while data are not included in this report, during this review EatSafe examined 12 structured databases and over 50 other data sources, covering all country income groups, and extracted key data relevant to the reviewed indicators; these data can be further subject to quality assurances, formatted, and piloted for potential visualization within the FSD.
- Engage with the FSD team to finalize the indicators for inclusion, the semi-quantitative indicator assessment methodology presented here, and apply the scoring scheme to evaluate the data for the final selection of recommended indicators;
- For indicators that show high potential, based on the steps above, submit a formal application for inclusion in the FSD.
- A future EatSafe activity will assess food safety indicators, including those reviewed here, and engage with local stakeholders, to determine whether the EatSafe countries could adopt and utilize food safety indicators for local use.

Other areas that warrant further consideration were identified, including:

- ***Indicators of System Performance***: Developing criteria that capture the performance value of indicators beyond the "yes/no" existence of a food safety capability or governance structure, such as the degree of development or functionality of a government agency or a private sector function would significantly increase the informational value and action-orientation of several indicators reviewed. However, performance rating approaches (e.g., rating the performance of a recall system) are new and only used by some country

agencies (often HIC), using ad hoc approaches that vary over time. While further investigation of such indicators for inclusion in the FSD is not recommended in the immediate future, this is an area to watch.

- ***Private Sector Data***: while these data are often less easily accessible, because available from different companies in different format, or because proprietary, when accessible they could be further leveraged. They could be particularly important in context where government data collection or sharing are not available.
- ***Export vs. Domestic Markets***: for some indicators, a better distinction between export and domestic markets would be necessary to ensure that the indicator is representative of the in-country situation.
- ***Focus on Prevention***: While investment and data collection often focus on "crises" such as response to outbreaks, laying the foundation for effective prevention is key to achieving public health results. Although data on food system components fostering prevention, such as training, laboratory capabilities, certifications, effective governance, and consumer engagement may be more complex to both collect and share, the choice of indicators to highlight in a dashboard should adequately prioritize preventive measures. EatSafe has sought to represent this focus in the range of indicators considered in this review.
- ***Consumer Perspectives***: While initial WRP data are promising, questions may be too specific to be highlighted in the FSD at this time, or their connection to stakeholder actions may be unclear; however, ongoing efforts to include consumer-centric indicators in the FSD is recommended, including establishing the mechanisms for future data updates.
- ***Stakeholder Involvement***: In-country stakeholders should be consulted in the definition and selection of food safety indicators. EatSafe regularly engages stakeholders for indicator development and implementation across global and country-specific areas. It should be noted that the considered set of indicators is also consistent with indicators compiled by WHO during stakeholder discussions (45).
- Alignment with the ***WHO Food Safety Strategy 2022-2030***. Indicators will be further discussed in the context of the newly published WHO strategy (46) to potentially include other indicators under development and better align this work with other global initiatives.

4. CONCLUSIONS

Incorporating food safety indicators into the FSD would advance its core objective of reporting accurate and actionable country-scale data to raise awareness on the level of development of key food system components and support programmatic decisions across food systems dimensions. At a basic level, it would more closely link the objectives of food safety and nutrition by giving stakeholders in the nutrition, food security, and food systems domains more tools to build awareness of the role of food safety. At a higher level, select food safety indicators could provide an actionable overview of the state of development of key components of food safety systems, mapped to the food system.

EatSafe conducted this review to identify whether there are relevant food safety indicators that should be considered for inclusion in the FSD and concluded that there are good candidates. The indicators recommended for further consideration cover the main components of food systems: health outcomes, supply chains (including retail as food environments), and consumers, as well as select components of the enabling environment (such as governance and

regulatory environment, the availability of training, or laboratory infrastructure). Each proposed indicator and their domain were evaluated and found to be relevant to the FSD Conceptual Framework, as the functions or capabilities captured by these indicators are relevant to assessing if a country's food safety system can protect consumers from unsafe food (1).

In addition, the recommended indicators were deemed relevant to policy and programming. Data availability, quality, and accessibility varied and are expected to pose hurdles, relatively to indicator attributes. Due to the lack of more nuanced data, for the most part indicators retained for further discussion were in the form of "existence or lack" of a national-scale food safety function or entity – as that was the level of detail of globally available, reliable data – and not representing the performance level of such entity. As such, these indicators can be useful in informing policy and programming decisions, although with considerable limitations. They can also be considered a valuable starting point to highlight the importance of food safety within food systems, and to call attention on the need for "higher-resolution" harmonized data to populate well-defined indicators.

In addition, to illustrate a more systematic approach to indicator scoring against FSD inclusion criteria, and to gauge the ability of FSD inclusion criteria to appropriately assess food safety indicators, EatSafe assessed a food-safety-relevant subset of the World Risk Poll, an existing global dataset. Conclusions from this assessment (Appendix 4) include:

- Food safety questions from the WRP (which can be seen as very specific potential indicators) performed well, overall, against FSD inclusion criteria and could be further discussed as representative of consumer's perspectives.
- The considered WRP questions performed particularly well under the Geographic coverage criteria, due to the exceptional global coverage of the WRP, and less well under the Action-Orientation criteria. In terms of Data Quality and Accessibility, the methodology is transparent and uniform, and the food safety questions on the survey will be repeated for at least several iterations.
- Further refinement of FSD inclusion criteria may be warranted to effectively include food safety in the FSD Conceptual Framework, in particular in terms of indicator attributes (relevance, action-orientation).
- A semi-quantitative scoring approach such as the one presented here can be used to assess the level of development and weaknesses of existing indicators and data.

Overall, this effort helps to understand the landscape of national-scale food safety indicators, to inform priorities for further indicator development and associated data collection efforts. This effort also identifies existing indicators (and their data sources) that are relevant to EatSafe's core work in traditional markets, and that may help EatSafe in selecting custom indicators to assess food safety interventions in traditional markets. EatSafe will share findings of this review, and the indicators recommended for further consideration for FSD inclusion with the FSD team.

While this review covers several key components of the food system, it was not designed to be comprehensive. EatSafe is well positioned to expand this review to include a broader range of existing datasets associated with food safety indicators and assess them using the scoring approach presented here. If additional suitable indicators or data sources are identified and deemed relevant by EatSafe and FSD stakeholders, a recommendation will be made on their potential inclusion in the FSD.

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6. APPENDICES

6.1. APPENDIX 1: FSD INCLUSION CRITERIA

The FSD developed a set of criteria to guide decision making on which indicators to include or add. These 16 criteria, which are evolving in tandem with the goals of the FSD, can be summarized in two main categories: indicator attributes and data attributes.

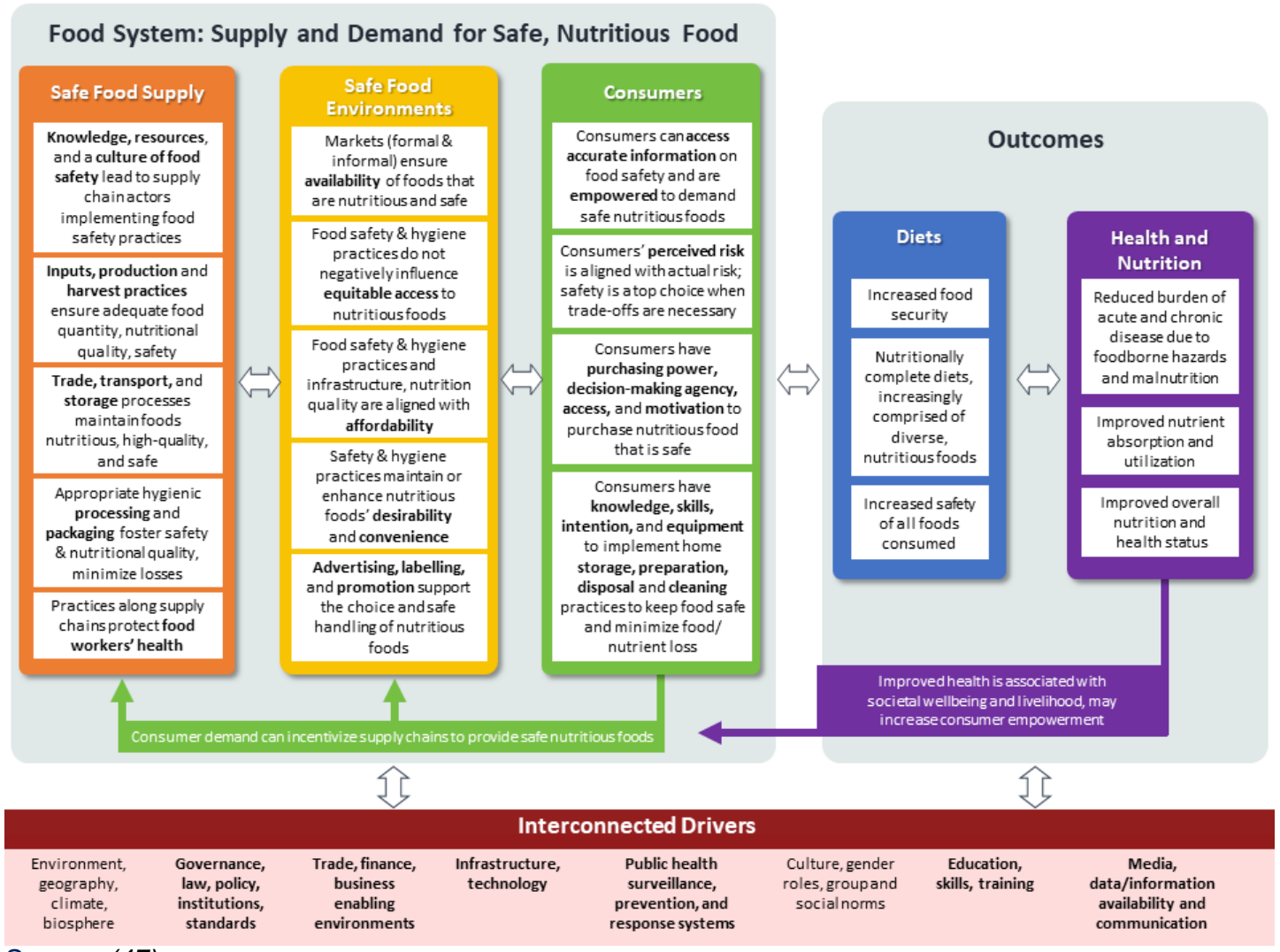
Indicator attributes include criteria related to the relevance of the indicator to the FSD conceptual framework, the validity of the indicator's methodology, and action-orientation (i.e., the usefulness of the indicator in tracking progress and informing programming decisions. Data attributes include the geographic coverage of available data, quality, accessibility, and timeliness of data that can populate an indicator.

An indicator is considered suitable for expert review and further consideration if it successfully meets the standards (i.e., yes to the yes/no question associated with each criterion) that were set in each category.

	CATEGORY	#	INCLUSION CRITERIA
INDICATOR ATTRIBUTES	Relevance	1	Maps to components of the food system (FSD Conceptual Framework)
		2	Measures characteristics relevant to nutrition, environmental health, equity
		3	Is unique among indicators included in the FSD
	Indicator methodology	4	Indicator definition and derivation is transparent, unbiased, vetted
	Action-orientation	5	Can be used to inform policy or program decisions
		6	Indicator is related to a threshold/cutoff relevant to FSD outcomes*
	Communication	7	Indicator is relatively easy to communicate and understand
DATA ATTRIBUTES	Data Geographic Coverage	8	Data are available for at least 50 countries
		9	Data are available for all regions of the world
		10	At least 50% country coverage within each region of the world
		11	Data is available for low-, middle-, and high-income country groups
	Data Quality and Accessibility	12	Data collection methodology is transparent and high-quality
		13	Data is available at the time of review
		14	Level of data accessibility (e.g., machine readable)
	Data timeliness	15	The most recent data are, at most, 10 years old
		16	The dataset is likely to be updated frequently in the future

** It is understood that this criterion does not apply to all indicators and is therefore not applied strictly.*

6.2. APPENDIX 2: FOOD SYSTEM FRAMEWORK THROUGH A FOOD SAFETY AND NUTRITION LENS



Source: (47)

6.3. APPENDIX 3: ANALYSIS OF FOOD SAFETY INDICATORS NOT RECOMMENDED FOR PRIORITY CONSIDERATION

GOVERNANCE AND POLICY

Existence of governmental food safety agency or authority (Indicator 2.1). A key signal of a country's food safety readiness is an independent national-level governmental structure (e.g., an agency within a Ministry or a designated food safety authority) focused on the safety and health of food that serves as the sole authority for food control management, communication, and coordination. They may be housed under the authority of Ministries of Agriculture or Trade Affairs. In terms of indicator attributes, the existence of a food safety agency signals a country's intent to place a strong focus on food safety, as opposed to having food safety functions fragmented among several governmental entities.

Main insights related to this domain include:

- For substantially all countries, including 13 of the Feed the Future target countries, information exists and can be obtained on the existence of a dedicated national food safety agency (as a yes/no variable); this information is generally available and relatively straightforward to obtain, although usually in individual countries' web sites and may not be machine readable.
- The existence of a food safety agency per se does not guarantee that it is operational. Hence this indicator is most useful to indicate countries lacking a dedicated governance structure for food safety. Indicators or approaches to rate the performance of food safety agencies were not considered in this review.

This indicator is not recommended for further investigation or inclusion in the FSD at this time, even if data on the existence of national food safety authorities exists, because this information is less information-dense and actionable than other indicators.

Existence of food safety policy and law (Indicator 2.2). Enabling policy and law is a prerequisite for the establishment and organization of national food safety systems. However, it was difficult to determine the state of regulatory enforcement and implementation within a country. In terms of indicator attributes, the existence of dedicated food safety policy and legislation indicates that a county is actively implementing or establishing food safety systems and integrating it into its legislative and enforcement mechanisms.

Main insights related to this domain include:

- The main source of data for this indicator was identified as the database of FAOLEX (10), including the respective FAOLEX Country Profiles (11). Both sources provide an overview of the food safety policy and legislation across all countries. However, the FAOLEX database includes information not only relevant to food safety, but also regarding similar thematic areas such as nutrition and agriculture; hence, distinguishing food safety policy from other areas is not always straightforward. To mitigate this issue, the Codex Country profiles database can also be leveraged in order to validate the status quo of each country in regard to food safety and consumer protection laws and regulations.

- Data on legislation focused on specific hazards and/or commodities may be available but would require a higher level of effort to identify and analyze. This level of detail would likely be inconsistent with the scope of the FSD, although some indicators on specific legislation (e.g., mandatory salt iodization) are currently included in the FSD.

This indicator is not recommended as a priority for inclusion in the FSD at this time, as further discussion would be necessary to identify specific legislation on commodities or hazards of widespread importance across many countries. However, such discussion is warranted, as the adoption and execution of legislation is most often a key step to ensure that food safety in a supply chain is managed with due attention.

Existence of food safety inspection system (private or public) (Indicator 2.4).
A national food safety inspection agency or system may represent a more advanced stage of a national food safety system development. In terms of indicator attributes, this indicator shows the commitment of a country to enforce food safety standards in supply chains and/or food environments. While the scope, in-country geographical coverage, and effectiveness or inspection systems varies, the existence of an inspection system is a strong signal that a country actively focuses on food safety enforcement. With several ongoing projects funded by a wide range of international donors aiming to establish local food safety controlling mechanisms, the state of national food inspection systems is evolving. For example, an ongoing project supported by USAID and implemented by Cornell, Kansas State, and Purdue Universities aims to strengthen local Cambodian inspection authorities (48).

Main insights related to this domain include:

- For most countries, including 14 of the Feed the Future target countries, information is available on whether a country has a food safety inspection system. This data can be found in Codex country profiles or in individual countries' agencies, as well as regional FAO/WHO networks (8). As for other components of national food safety systems considered here, the information on the existence of an inspection agency (yes/no) is relatively easy to obtain, although language and data readability obstacles exist.
- An indicator capturing the level of development or performance of an inspection agency does not seem viable at the time of this review.

This indicator is considered a slightly lower priority for inclusion in the FSD at this time, in that it may provide similar information on a country status as other indicators that are recommended for further consideration, in particular Indicator 1.1 – Existence of a recall or early-warning system, and Indicator 2.1 – Existence of a dedicated food safety agency. Data availability and quality for this indicator are also comparable to the two indicators above. Hence, it is recommended that this indicator is discussed in the context the two indicators above and other components of a national food safety system.

SUPPLY CHAIN AND THE CONSUMER

Food traceability in export and domestic markets (Indicator 3.4). International trade agreements require effective food traceability systems for both export and domestic markets. These systems are particularly important for countries that produce high value commodities

for global export (e.g., coffee in Colombia and cocoa in Côte d'Ivoire), as these products are distributed to a range of processors and eventually consumers.

In a preliminary review, the data for this indicator was found lacking for most countries. Only 2 of the 20 Feed the Future countries had data available for this indicator. Where the data exists, it is available mostly through local food authorities or through bilateral agreements for food traceability between countries. In addition, the presence of a tracing system for export supply chains does not imply that a traceability mechanism is available for domestic markets. Countries with tracking systems were identified through national food authorities (e.g., the U.S. Food and Drug Administration), bilateral agreements for food traceability between countries, FAO's country digital profiles published (e.g. Côte d'Ivoire (49)) or industry-supported initiatives for high value commodities (e.g., cocoa (50)).

In terms of indicator attributes, this is an advanced indicator, as only well-established food safety systems and formal supply chains would be able to support a traceability system. As such, while this function – when well established – has proven very effective in preventing and responding to food safety outbreaks, it is less relevant to countries that do not yet have a fully functioning food safety system.

In conclusion, this indicator is not recommended for further consideration for FSD inclusion at this time.

6.4. APPENDIX 4: SCORING FOOD SAFETY INDICATORS AGAINST FSD CRITERIA

This section presents methods and results for an additional goal of this work: developing and applying a scoring scheme based on the original FSD inclusion criteria to a group of specific indices from one dataset, namely a set of World Risk Poll (WRP) survey questions relevant to consumers' perspectives on food safety. WRP questions relevant to food safety were reviewed qualitatively in Section 2 (i.e., Indicator 3.6 – Consumer perspectives under the umbrella indicator of Consumer Perspectives). This section also includes discussion on whether current FSD inclusion criteria are compatible with food safety indicators, highlighting areas for further harmonization.

METHODS

World Risk Poll Questions: EatSafe examined several datasets as the focal point for this preliminary test of the applicability of the FSD inclusion criteria (Appendix 1) for food safety datasets and chose the Lloyd's Register Foundation's World Risk Poll (WRP) for the initial analysis (14). The WRP is a global survey covering a variety of categories of consumer risk and worry, executed by Gallup, which encompasses around 150,000 people from over 140 countries. The WRP aims to capture peoples' attitudes toward risk around a range of topics, including but not limited to the safety of food and water. Designed for use by cross-sectoral decision-makers (e.g., businesses, regulators, and researchers), the WRP was first deployed in 2019, with the next iteration expected in late 2021.

Only a subset of questions in the WRP dataset are directly relevant to food safety. Following a comprehensive review of the WRP dataset and available documentation, EatSafe selected eight questions relevant to food safety, including some on waterborne risk. The selected questions, summarized in **Table A1,** cover topics related to health outcomes, extent of perceived risk, risk management options, and food safety governance.

Table A1. *WRP Questions Identified for Inclusion in the Preliminary Suitability Assessment*

CODE*	WRP QUESTION
REPORTED HEALTH OUTCOMES	
A	% who "experienced serious harm" from eating food in past two years
B	% who "experienced serious harm" from drinking water in past two years
EXTENT OF PERCEIVED RISK	
C	% who are "very worried" that the food one eats could cause harm
D	% citing food- or water-borne disease as "greatest source of risk" to one's safety in their daily life
RISK MANAGEMENT	
E	Sources respondents look to for information on the safety of foods they eat
F	Most trusted source of food safety information
GOVERNANCE	
G	% who believe government should enforce adoption of safety procedures
H	% who believe government does a "good job ensuring" food safety
I	Government Safety Performance Index (GSPI)[2]

[2] The Government Safety Performance Index (GPSI) is an aggregate measure of public perceptions of government performance in ensuring safety of food, water, and electrical infrastructure. The Index is computed based on responses to "Yes/No" survey questions about whether the respondent believes the government does a "good job ensuring" these three areas are safe.

Assessing WRP Suitability for Inclusion in the FSD. An assessment of the suitability of selected WRP questions for inclusion in the FSD is presented here as an illustrative example of application of a quantitative scoring scheme based upon existing FSD inclusion criteria. While this quantitative scheme is not currently a part of the FSD inclusion process, EatSafe developed this approach to aid in assessing indicators -and associated datasets- beyond a binary "yes or no" inclusion decision, to help articulate how far an indicator is from meeting inclusion criteria and why. Importantly, EatSafe's semi-quantitative approach and any further refinements could also aid in assessing indicators outside of the food safety area, including those that may not currently be suitable for inclusion in the FSD. This scoring scheme is being proposed as a tool that the FSD team could use in future indicator assessments.

EatSafe scored each WRP question against the inclusion criteria using a 0-4 scale, where:

- 0 is "unacceptable"
- 1 is "needs considerable improvement to become acceptable"
- 2 is "acceptable with weaknesses"
- 3 is the "target" level of acceptability for FSD purposes (corresponding to "Yes")
- 4 is an "exceeding" level of acceptability.

Using the quantitative scores for each criterion, a heatmap was also used to visualize higher- and lower-performing areas within the FSD inclusion criteria (**Table A2**). EatSafe identified strengths and weaknesses of each indicator by (i) evaluating the score and color differential across criteria, and (ii) computing the mean score for each indicator across all FSD criteria. WRP questions with composite scores greater than or equal to three ("target") could be considered strong candidates for inclusion in the FSD, while those with composite scores less than three were found unlikely to be eligible under current FSD inclusion criteria.

Evaluating Alignment Between Indicators and Inclusion Criteria. Given that the FSD Conceptual Framework was not specifically designed to incorporate food safety indicators, EatSafe anticipated from the outset of this work that some metrics and datasets under consideration for inclusion in the FSD may under-perform against one or more of the existing FSD inclusion criteria shown in Appendix 1. EatSafe recognizes that the FSD criteria are in the process of being updated, the example illustrated here demonstrates the use of a systematic approach that could aid in rapidly and visually evaluating the strengths and weaknesses of considered indicators.

EatSafe thus undertook an additional assessment of indicators to identify key gaps and elucidate potential areas where revising the FSD inclusion criteria may successfully accommodate food safety indicators.

EatSafe identified the inclusion criteria least suited for food safety indicators by examining the lowest-performing indicators on the heatmap. For each inclusion criterion that had comparatively lower mean scores across questions assessed (i.e., <3), EatSafe conducted a qualitative assessment to identify whether the shortcoming reflected a gap in the ability of the FSD inclusion criteria to accommodate food safety indicators or if it reflected a fundamental incompatibility or weakness of the indicator itself. The appraisal for each indicator followed a two-step process: i) positioning of the "shortcoming" indicator within the existing FSD Conceptual Framework; and ii) visioning for possible modifications to the Conceptual Framework to accommodate the indicator in question.

METHODS

Assessment of WRP Suitability for Inclusion in the FSD. The questions selected from the WRP for this illustrative analysis performed well against the FSD inclusion criteria, with six of the nine questions meeting or exceeding the target composite score (A-F in **Table A2**). The heatmap shown in this table has WRP questions on one axis and FSD criteria on the other, with color-coding corresponding to the score ranges. The visualization uses a red-white-blue spectrum, where scores closer to 0 ("unacceptable") are shades of red, scores closer to 3 ("target") are white, and scores higher than the target are blue.

The highest-performing questions, based on this preliminary assessment, were those related to Reported Health Outcomes (Questions A and B, see **Table A1**). Questions on the Extent of Perceived Risk or worry/concern about food safety (Questions C and D) as well as questions on sources of information (Questions E and F) also performed well but fell short of the health-related indicators in the Action-Orientation, Easiness of communications, and some of the Relevance criteria. Questions in the Food Safety Governance domain (Questions G, H, I) scored the lowest, in particular due to potential mismatches with Relevance to the FSD conceptual framework, Action-orientation, or Easiness of Communication. It is important to note that this scoring is an illustrative example, developed before extensive dialogue with the WRP team, and is meant to prompt further discussion and not as a definitive evaluation of the value of WRP questions.

All indicators received "exemplary" scores for indicators in the Coverage category, a finding that reflects the expansive geographic scope and scale of the WRP, which applies to all questions equally. Compared to other food safety-related datasets, the WRP is unique in its geographic breadth, making it an appealing candidate to add rare consumer perspective indicators on food safety to the FSD. All but two questions (both pertaining to food safety governance) met the target level (3 or more) in the Relevance category, indicating reasonable consistency with the existing inclusion criteria. Overall, scores in the Indicator Methodology (Criterion 4) and Action-Orientation (Criterion 5) categories were generally less successful than in the Coverage and Relevance categories, mainly due to the novel nature of these potential indicators, which have not yet been widely recognized and used by other organizations. Indicators in the Food Safety Governance domain (Questions G, H, I) scored less than other questions, in particular in the Indicator Relevance, Action-orientation, and ease of communication. The comparatively lower scores of the Food Safety Governance domain (Questions G, H, I) can be attributable to the novel and personal perspective nature of these questions, that may not currently have explicit ties to food system policy or nationals-scale programs. However, since the FSD was not designed to include food safety concepts, such discrepancy suggests that the FSD conceptual framework may need to be expanded to better account for the role of food safety in food systems (see next section). This need, and the broader need for programmatic links between nutrition and food safety frameworks, was the focus of another EatSafe activity (47).

Table A2. *Heatmap of Strength and Gap Areas Across WRP Questions*

WRP Qs	FOOD SYSTEMS DASHBOARD INCLUSION CRITERIA																
	Indicator relevance				Indicator methodology, action-orientation, communication			Data geographic coverage				Data quality and accessibility			Data timeliness		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	MEAN SCORE
A	4	4	4	3	3	3	4	4	4	4	4	4	4	3	3	3	3.63
B	4	4	4	3	3	3	4	4	4	4	4	4	4	3	3	3	3.63
C	3	3	4	3	3	2	4	4	4	4	4	4	4	3	3	3	3.44
D	2	3	4	3	3	2	4	4	4	4	4	4	4	3	3	3	3.38
E	3	2	4	3	3	2	4	4	4	4	4	4	4	3	3	3	3.38
F	4	3	4	2	3	1	3	4	4	4	4	4	4	3	3	3	3.31
G	3	2	4	2	2	1	3	4	4	4	4	4	4	3	3	3	3.13
H	1	2	4	2	2	1	3	4	4	4	4	4	4	3	3	3	3.00
I	1	1	4	2	3	1	2	4	4	4	4	4	4	3	3	3	2.94

*Note: A-I: WRP questions (see **Table 3**); 1-13: inclusion criteria (see **Table 2**). Scores ranged from 0 ("unacceptable"; red) to 4 ("exemplary"; blue), with a value of 3 (white) representing the target level.*

Alignment Between WRP and FSD Inclusion Criteria. In this portion of the analysis, we placed the focus on the FSD inclusion criteria themselves, critically assessing each of them against two questions:

1. Assuming that food safety is an integral part and objective of food systems, is this criterion applicable to and adequately inclusive of food safety indicators?
2. Would it be feasible to rephrase the criterion to mitigate a discrepancy between the criterion and the nature and format of food safety indicators?

This qualitative assessment focused on the WRP questions reviewed in the previous sections, which cover multiple indicator topics including health outcomes, perceived risk, risk management options, and food safety governance. At the same time, the broader landscape of food safety indicators reviewed in the main body of the report was kept in mind, so that the insights derived here could be applicable to a broader set of domains. When averaged across all WRP questions, five of the 16 inclusion criteria (i.e., criteria 1, 2, 4, 5, 6) yielded scores below the target value of 3, highlighting potential mismatches between criteria and indicators. The following section suggests potential explanation for this result, as well as implications for inclusion of any food safety indicators into the FSD Conceptual Framework.

The shortcomings of **criterion 1** (a direct connection to the existing FSD Conceptual Framework), warrants further consideration for potential adaptation. An examination of scores for criterion 1 indicates that the present FSD Conceptual Framework is not well-equipped to accommodate indicators related to food safety governance – a key element of food safety behaviors, practices, and decision-making.

Criterion 2 (having a connection to nutrition, environmental health, or equity), in the Relevance category, fell short of the target value. Among the nine WRP questions, only a handful met or exceeded target values for criterion 2, illustrating that many food safety indicators may not make the link to nutrition outcomes explicit, which is expected. None of the eligible WRP questions made direct or indirect linkages to environmental health or equity, which may be areas harder to encapsulate in globally representative food safety survey efforts. In this case, the FSD criterion may need to be expanded, if food safety must be meaningfully represented in the FSD.

Criterion 4 (Indicator definition and derivation is transparent, unbiased, and vetted) received a low overall score averaged across the considered WRP questions – an understandable result given that many of the WRP food safety indicators pertain to users' perceptions and are rather novel in the context of globally-representative public opinion surveys. The shortcoming of the selected indicators against criterion 4 is likely attributable to both the novelty and specificity of the WRP – not the inability of the FSD inclusion criteria to accommodate food safety-related indicators. As the reputability and validity of the FSD indicators continue to solidify, the WRP's performance against criterion 4 would also likely improve. For example, the WRP itself has garnered substantial trust among the survey population and some peer-reviewed articles have cited WRP indicators (51,52). Other food safety indicators with wider usage and established validity would likely perform better in this category.

Inclusion **criteria 5** and **6** (applicability to inform policy or program decisions, and linkage to specific threshold values deemed necessary for human health, respectively) also did not achieve target levels. Though the FSD Conceptual Framework cites **criterion 6** as an

optional inclusion criterion that does not apply to all indicators (i.e., it is not a strict criterion for inclusion), its shortcomings were understandable, given the nuanced and novel nature of WRP question. This shortcoming is expected to also apply to many national-scale food safety indicators; therefore, this criterion may need to be reconsidered or made more flexible when applied to food safety-related indicators. **Criterion 5** closely resembled the results of criterion 4 in its characterization of the WRP questions. Due to the highly-subjective and personal nature of the WRP indicators – a unique feature of this dataset compared to most food safety-related data – many of the included indicators were not explicitly tied to policy or intervention programming decisions beyond an assessment of cultural context. However, a range of national-scale food safety indicators (i.e., monitoring, and regulatory standards, disease prevalence, morbidity/mortality, etc.) may perform much more highly against this criterion than those WRP indicators selected for assessment in this report. Nonetheless, consumer perspectives can provide a very valuable input into programs related to perceived and consumer response to risk, interactions with and perception of government entities, and access to information.

In contrast, the WRP questions performed well against geographic coverage criteria (**Criteria 8-11**), due to the nature of this survey effort. If it expects that several other food safety indicators would perform more poorly in this category. Similar considerations apply to Data Quality and Accessibility criteria (**Criteria 12-14**). The WRP surveys are applied uniformly across the target countries; the methodology for data collection is clear and transparent; and results are openly available. While data accessibility is adequate, at this time data do not seem to be machine readable and would require manual handling to be processed and uploaded into the FSD. This aspect (**Criterion 14**) requires careful discussion to weigh the importance of indicator attributes against the efforts necessary to obtain and update the data and is expected to apply even more to other national-scale food safety indicators due to the heterogeneity of data collection and management systems.

Lastly, criteria related to data timeliness (**Criteria 15 and 16**) accurately captured the strengths and weaknesses of WRP data: the data is recent (2019), and the survey will be conducted four times more, every two years until 2025, hence the current score is high but may rapidly lose time relevance afterwards. This is not unique to this set of potential indicators, as data collection campaigns on other food safety indicators may also be limited in time. However, it is likely that core national-scale indicators such as those reviewed in the main report will either not change rapidly or would be the subject of ongoing data collection. Frequency of data collection, and frequency of updates of publicly available databases, however, are an aspect that warrants scrutiny and may require more research during indicator assessment.