The effects of food systems interventions on food security and nutrition outcomes in low- and middle-income countries

January 2021

Evidence Gap Map Report 16

Health
About 3ie

The International Initiative for Impact Evaluation (3ie) promotes evidence-informed equitable, inclusive and sustainable development. We support the generation and effective use of high-quality evidence to inform decision-making and improve the lives of people living in poverty in low- and middle-income countries. We provide guidance and support to produce, synthesise and quality assure evidence of what works, for whom, how, why and at what cost.

3ie evidence gap map reports

3ie evidence gap maps are thematic collections of information about impact evaluations and systematic reviews that measure the effects of international development policies and programmes. The maps provide a visual display of completed and ongoing systematic reviews and impact evaluations in a sector or sub-sector, structured around a framework of interventions and outcomes.

The evidence gap map reports provide all the supporting documentation for the maps, including the background information for the theme of the map, the methods and results, the protocols, and the analysis of results.

About this evidence gap map report

This report presents the findings of a systematic search to identify and map the evidence base of impact evaluations and systematic reviews of interventions that assess the effects of food systems interventions on food security and nutrition outcomes. The content of this report is the sole responsibility of the authors and does not represent the opinions of 3ie, its donors or its board of commissioners. Any errors and omissions are also the sole responsibility of the authors. Please direct any comments or queries to Charlotte Lane at clane@3ieimpact.org.


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The effects of food systems interventions on food security and nutrition outcomes in low- and middle-income countries

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Evidence Gap Map Report 16
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Summary

Introduction

The International Initiative for Impact Evaluation (3ie) and Innovative Methods and Metrics for Agriculture and Nutrition Actions research group were commissioned by Deutsche Gesellschaft für Internationale Zusammenarbeit in February 2020 to undertake an evidence gap map (EGM) of the effects of food systems interventions on food security and nutrition outcomes.

This project aims to inform decision-making by making relevant evidence accessible to policymakers, researchers and the development community. This will be done by identifying and describing the available evidence in a clear and structured way. As such, this EGM has two specific objectives:

1. Identify and map the available evidence on the effects of food systems interventions on food security and nutrition outcomes in low- and middle-income countries (L&MICs); and
2. Identify potential primary and synthesis evidence gaps.

What is an EGM?

3ie evidence gap maps are thematic collections of information about impact evaluations and systematic reviews that measure the effects of international development policies and programmes. These maps provide a visual and interactive display of completed and ongoing systematic reviews and impact evaluations in a sector or sub-sector, structured around a framework of interventions and outcomes. EGMs highlight both absolute gaps (an empty cell in the framework), which could be filled with new primary studies, and synthesis gaps (multiple impact evaluations but no systematic reviews), which could be filled with evidence synthesis. This map can be found available online here.

Background

The triple burden of malnutrition refers to the concurrent presence of undernutrition, micronutrient deficiencies and excessive energy intake (i.e. overweight and obesity) in a given population. The presence of all three forms of malnutrition is increasingly seen as a prevailing global issue. Current estimates suggest that 690 million people, or just under 9 per cent of the global population, experience hunger. At the same time, worldwide obesity nearly tripled between 1975 and 2014, with over 1.9 billion adults classed as overweight in 2016, of whom 650 million were obese. The prevalence of this triple burden is also thought to be affected by constraints within food systems, which are often observed in L&MICs, and the complexity of food systems themselves.

In response to these continuing challenges, the number of interventions to support healthy nutrition and evaluations of these interventions has increased substantially in recent years. While efforts to coordinate policy and research in the sector exist, available funding to support intervention within the food system is not considered to be sufficient to address future malnutrition issues. By mapping out the existing systematic and impact evaluation evidence in this sector more clearly, this EGM aims to improve the accessibility of research and to support more efficient allocation of resources.
Methods

To generate this EGM, the standards and methods for EGMs developed by 3ie were followed (Snilstveit et al. 2016; 2017). The steps taken to create this map are summarised below.

Subject scope development: Relevant policy documents, identified together with Deutsche Gesellschaft für Internationale Zusammenarbeit, were reviewed. From these, several existing food systems frameworks were identified. A selected and adapted framework (HLPE 2017) was presented to a group of Deutsche Gesellschaft für Internationale Zusammenarbeit policy stakeholders for feedback. The final framework used to map studies is summarised below.

EGM scope summary

<table>
<thead>
<tr>
<th>Interventions</th>
<th>Outcomes</th>
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<tbody>
<tr>
<td><strong>Food value chains</strong></td>
<td><strong>Food security &amp; nutrition</strong></td>
</tr>
</tbody>
</table>
| Production system | ▪ Anthropometric
| ▪ Distribution & storage | ▪ Developmental
| ▪ Processing & packaging | ▪ Micronutrient deficiencies
| ▪ Food loss & waste mngr. | ▪ Diet quality & adequacy
| Food environment | ▪ Food safety
| ▪ Availability and provision (proximity) | ▪ Food affordability & availability
| ▪ Affordability | ▪ Information / behaviour change
| ▪ Promotion and labelling | ▪ Efforts to improve women’s empowerment in food systems
| ▪ Quality & safety |

Source: 3ie 2020; adapted from HLPE 2017.
Note: The bi-directional arrows seek to highlight that intervening in one stage of the food system may have implications for activities at another stage.

Specification of eligibility criteria: A population, intervention, comparator, outcome and study design framework was adopted. Topically relevant systematic reviews and experimental – as well as a subset of quasi-experimental – quantitative impact evaluations were included. The time period considered studies published in or after 2000.

Search, screening and data collection: Twelve academic bibliographic databases were screened systematically in May 2020 using the criteria above. This was complemented with manual searches of 31 sector-specific databases and websites, also engaging with the research community. Studies were screened against set eligibility criteria. All included studies were checked to make sure they were not linked to other included studies, and coded using a pre-specified coding framework to collect study characteristics. All systematic reviews were appraised for the quality of methods used to search for and synthesise study effects. After implementing quality assurance processes, descriptive statistics were calculated on the data collected to answer respective research questions.
Results

Research question 1: What are the extent and characteristics of existing empirical evidence regarding the effects of selected food systems interventions on food security and nutrition outcomes in L&MICs?

Size of the evidence base: A total of 1,838 impact evaluations and 178 systematic reviews were identified. The volume of publications has increased more than a hundredfold since 2000, mostly due to increases in research into food supply chains and consumer behaviour.

Population coverage: Most impact evaluations were conducted in lower middle-income countries, particularly in Sub-Saharan Africa and South Asia. Impact evaluations were conducted in most fragile states. Interventions evaluated in fragile states are somewhat similar to those in all L&MICs. Impact evaluations primarily targeted both sexes and people of diverse ages, except those over 60. Over half of interventions were conducted in rural areas, and most of those evaluated were local in scale, with administration most commonly performed at the household level.

Intervention coverage: All interventions with at least 50 impact evaluations have been synthesised by at least one systematic review. The most common intervention categories, each with over 100 impact evaluations and typically at least 20 systematic reviews, were: the provision of supplements, fortification, classes in the consumer behaviour domain, direct provision of foods, and peer support and counselling in the consumer behaviour domain. Several studies evaluated programmes that combined multiple food systems interventions.

Outcome coverage: The most common final outcomes evaluated in studies were categorised as anthropometric, micronutrient status, and diet quality and adequacy. The most common intermediate outcome categories were economic, agricultural and intrinsic motivational outcomes. In particular, the most common final impact evaluation outcomes were linear growth, iron status, weight and relative weight; the most common intermediate outcomes were behaviour change, knowledge, income and plant production. Most studies evaluated only final outcomes, but over time, studies have increasingly considered intermediate outcomes.

Study design coverage: Roughly three quarters of impact evaluations implemented randomised designs, and few triangulated effects with qualitative or cost analysis. Meta-analysis was the most common synthesis method, and most systematic reviews sought to understand how effects might vary between different groups.

Systematic review confidence rating: Most reviews were of low confidence with regard to their conclusions: 95 of completed reviews scored a ‘low’ confidence rating (54%); 46 (26%) were rated ‘medium’ confidence; and 34 (19%) were rated ‘high’ confidence. High-confidence reviews were mostly published in or after 2015 and are focused on synthesising the available evidence on the effects of supplementation and fortification interventions.
Research questions 2 and 3: What are the major primary and synthesis evidence gaps in the literature that could be prioritised for primary research and/or evidence synthesis?

Below is a partial list of interventions and outcomes that were identified as understudied, which may be of interest to stakeholders when considering the allocation of research and programming resources.

Illustrative list of interventions to prioritise for evaluation

- Government manipulations of price
- Advertising and labelling regulations
- On-farm, post-harvest processing
- Interventions to support food packaging
- Efforts to support women’s empowerment within the food system
- Innovative store design
- Cold chain storage

Illustrative list of outcomes to prioritise for evaluation

- Women’s empowerment
- Economic, social and political stability
- Food loss
- Environmental impacts of the food system
- Measures of diet insufficiency

Illustrative list of evidence synthesis priorities

- Agricultural extension and information-sharing activities within the food value chain
- Provision of free or reduced-cost farm inputs to crop production
- Educational approaches within the food value chain
- Agricultural insurance products
- Outcomes related to other diet quality and adequacy measures

Implications

It was found that the number of systematic reviews and impact evaluations in the sector has substantially increased in the last two decades. The mapping identified several well-researched areas but also areas that are potentially not well researched. Based on the results of the mapping project, findings from the EGM suggest the following implications for policy and research:

Policy

Use high-quality systematic review evidence: Make use of existing high-quality systematic reviews if their focus is relevant to your area of focus.

Allocation of resources: Consider allocating resources to fund studies in the identified areas that are potentially under-researched. Exercising caution prior to programme implementation is recommended in areas where no studies were found, such as those related to labelling and advertising regulations. Contextualise any resource allocation made using this map with the following information sources:
• Existing or planned research and interventions by government agencies and development partners;
• Other forms of evidence, including implementation research, process evaluations, qualitative studies, and programming administrative and monitoring information;
• Existing theories of change and logical frameworks; and
• Your own formative work and local knowledge.

Research

Building on well-researched areas: Well-researched areas may benefit from additional research if questions become more focused on specific contexts or populations, or the efficacy of implementation procedures.

Standardising diet outcome indicators: To aid comparison and improve evidence synthesis efforts, consider standardising outcome measures relating to diet quality and adequacy, as multiple used measures were identified by the authors.

Incorporating mixed methods and cost data: Few studies were based on mixed methods or collected and analysed cost data. Future studies could provide new insights by incorporating these methods.

Dealing with complexity: Studies and reviews should consider the complexity of food systems as far as is feasible. In the case of impact evaluations, this might mean considering quasi-experimental designs where randomised evaluations are not possible. More generally, a good starting point would be to consider how different drivers that affect the food system (as defined in HLPE 2017) might influence an intervention or population of interest.
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### Abbreviations and acronyms

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<td>EGM</td>
<td>Evidence gap map</td>
</tr>
<tr>
<td>L&amp;MICs</td>
<td>Low- and middle-income countries</td>
</tr>
<tr>
<td>PICOS</td>
<td>Population, intervention, comparator, outcome and study design</td>
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1. Introduction

The International Initiative for Impact Evaluation (3ie) and the Innovative Methods and Metrics for Agriculture and Nutrition Actions research group were commissioned by Deutsche Gesellschaft für Internationale Zusammenarbeit in February 2020 to undertake an evidence gap map (EGM) of the effects of food systems interventions on food security and nutrition outcomes. This EGM report presents the findings of a systematic search to identify and map the evidence base of impact evaluations and systematic reviews of food systems interventions that aim to improve food security and nutrition outcomes.

1.1 Study aim, objectives and research questions

By identifying, describing and summarising the available evidence in a clear and structured way, this project aims to make evidence accessible to policymakers, researchers and the development community. Ultimately, this map also seeks to facilitate the use of evidence to inform policy decisions. To meet these aims, the EGM has two specific objectives:

1. To identify, describe and summarise evidence on the effects of food systems interventions on food security and nutrition outcomes in L&MICs; and
2. To identify potential primary and synthesis evidence gaps.

The research questions shown in Table 1 sought to address these objectives.

Table 1: EGM research questions

<table>
<thead>
<tr>
<th>No.</th>
<th>Research question</th>
<th>Type</th>
</tr>
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<tbody>
<tr>
<td>RQ1</td>
<td>What are the extent and characteristics of existing empirical evidence regarding the effects of food systems interventions on food security and nutrition outcomes in L&amp;MICs?</td>
<td>Coverage</td>
</tr>
<tr>
<td>RQ2</td>
<td>What are the primary and synthesis evidence gaps in the literature?</td>
<td>Gaps</td>
</tr>
<tr>
<td>RQ3</td>
<td>What intervention and/or outcome areas could be prioritised for primary research and/or evidence synthesis?</td>
<td>Research needs</td>
</tr>
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1.2 What is an EGM and how is it used?

An EGM aims to establish what is known and unknown about an evidence base in a thematic area (Sniltstveit et al. 2016). A map is populated by systematically searching and screening all relevant completed and ongoing systematic reviews and impact evaluations against a set of pre-specified inclusion and exclusion criteria. All studies that met these criteria are mapped onto a framework of interventions and outcomes and presented on an interactive platform, which provides a graphical display of the evidence in a grid-like framework.

This presentation displays the volume of evidence for all intervention-outcome combinations, the type of evidence (impact evaluation, systematic review, completed or ongoing), and a confidence rating of each systematic review. The final map is published on an online interactive platform that provides additional filters so that users can further explore the available evidence (e.g. by global region, income levels or population).
EGMs highlight both absolute gaps (an empty cell in the framework), which could be filled with new impact evaluations, and synthesis gaps (multiple impact evaluations but no systematic reviews), which could be filled with evidence synthesis. They can also be used to highlight potentially over-researched areas, where the effects of a particular intervention have been evaluated against a range of outcomes (or vice versa), and where additional studies may not be as necessary.

However, just because an EGM identifies a gap, it does not necessarily mean this gap is meaningful. Apparent gaps can occur for several reasons, including:

- **Well-established effects**: The impact (or lack thereof) may have been well established before the search period. In such a case, there is no need for subsequent studies investigating already established impacts.

- **Limited underlying theory**: There may be no theoretical reason to expect the intervention to affect the outcome. Investigating these areas might lead to incorrect conclusions due to the potential for spurious correlations.

- **Methodological and practical limitations**: It may be difficult to conduct impact evaluations on a given intervention. There may be other sources of information, such as qualitative work or process evaluations, that consider the topic of impact without fulfilling the inclusion criteria for this map. Studies may also have been conducted but not published (e.g. because no significant effects were found).

- **Studies not captured within this EGM**: Although a comprehensive search was undertaken, it is possible that some impact evaluations are not included in this EGM due to language or date restrictions, lack of identification through the search approach, or other potential oversights.

- **Existence of meaningful knowledge gaps**: Finally, there may be meaningful knowledge gaps that represent opportunities for future research. These gaps can be especially concerning when an intervention has been widely implemented without sufficient evidence, under the assumption that it will affect an outcome or set of outcomes.

Ultimately, EGMs are envisioned as a global public good, and this allows them to be used as tools to facilitate access to high-quality research to inform development policy decision-making. Several examples of how this EGM could be used to inform decision-making are provided in Appendix G.

### 1.3 Remainder of this report

The remainder of this report is presented as follows:

- **Section 2** presents the subject background.
- **Section 3** presents the scope and method.
- **Section 4** presents the results.
- **Section 5** concludes and provides a set of considerations for using the EGM.
2. Background and rationale

2.1 The problem, condition or issue

2.1.1 The triple burden of malnutrition is a prevailing global issue.

The triple burden of malnutrition refers to the concurrent presence of undernutrition, micronutrient deficiencies and excessive energy intake (i.e. overweight and obesity) in a given population (UNICEF 2019). Past data and the latest current data show that different forms of malnutrition persist globally.

Current estimates indicate that 690 million people, or just under 9 per cent of the global population, experience hunger (FAO 2020) and 2 billion people lack key vitamins and minerals in their diets (Scott 2017). Micronutrient deficiencies are worse amongst children, with one half of all children currently thought to be suffering from at least one form of deficiency (UNICEF 2019). Less than one fifth of all children aged 6–23 months in UN-designated least-developed countries were also reported to receive a minimally acceptable diet (ibid).1

Finally, just over one fifth of the world’s children under age 5 were stunted in 2019 (UNICEF 2020). In 2011, undernutrition and micronutrient deficiencies contributed to 45 per cent of all childhood deaths (Black et al. 2013). Although the prevalence of hunger had been steadily declining, this trend reversed in 2015, taking us further from the SDG 2 goal of ending hunger by 2030 (FAO 2019).

At the same time, worldwide obesity nearly tripled between 1975 and 2014, with over 1.9 billion adults classed as overweight in 2016, of whom 650 million were obese (NCD RisC 2017; WHO 2020). The proportion of overweight children aged 5–19 years doubled from 10 per cent in 2000 to 20 per cent in 2016 (UNICEF 2019). Obesity was estimated to have contributed an additional four million deaths each year between 1980 and 2015 (GBD 2015 Obesity Collaborators 2017), and unhealthy diets now represent a greater contributor to mortality and morbidity than unsafe sex, alcohol, drugs, and tobacco combined (Haddad et al. 2016; Willett et al. 2019).

2.1.2 Malnutrition can occur due to food system malfunction, particularly in L&MICs.

These issues are acute in L&MICs, where the prevalence of the triple burden of malnutrition is highest, especially in fragile states (Development Initiatives 2020). In particular, undernutrition and micronutrient deficiencies are increasingly coupled with the problems associated with obesity (Popkin et al. 2020) – primarily diet-related cardiovascular diseases (Danaei et al. 2014).

The transition of food systems towards ‘Western’ diets, often associated with increased sedentary lifestyles, is thought to be a key driver of the triple burden of malnutrition (Haddad et al. 2016). Researchers have attributed this nutrition transition to a number of interlinked factors, including increased globalisation, per-capita income growth and

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1 Least-developed countries or areas are classified as such by the United Nations High Representative for the Least Developed Countries, Landlocked Developing Countries and Small Island Developing States. More information is available at: https://data.unicef.org/regionalclassifications [Accessed: 10 November 2020].
changes to food environments – for example, growth in the so-called ‘retail revolution’ or increased access and promotion of ultra-processed foods (Popkin et al. 2020).

These changes have made foods with low nutrient density and high caloric density more accessible, affordable and ultimately more desirable to end consumers (ibid). In contrast, healthy and culturally appropriate diets are often more expensive (Darmon and Drewnowski 2015; Dizon and Herforth 2018) and less accessible, especially in low-income and rural contexts (Development Initiative 2020). This can result in serious socio-economic disparities in diet and, as a consequence, diet-related non-communicable diseases (Darmon and Drewnowski 2015).

2.1.3 **Efforts to improve food systems must also consider other ongoing challenges due to the interconnectedness of these systems.**

The challenges of our era – such as climate change, economic growth, urbanisation, globalisation and scarce natural resources – continue to put food systems under stress (Haddad et al. 2016; Willett et al. 2019). To meet growing demand, it is thought that food production needs to increase by 50 per cent before 2050 (FAO 2017), but that markets and existing food systems will not be able to support the needs of a growing population without inducing severe, irreversible environmental damage (UNEP 2019; Springmann 2018; UNSCN 2019).

The same dietary alterations that produce more sustainable food systems can also lead to healthier lives, potentially preventing 10.8 to 11.6 million deaths a year (Willett et al. 2019). These changes include a reduction of meat and processed food consumption with a corresponding increase in the consumption of fruits and vegetables. Food systems also need to be designed to be robust to climatic shocks (Myers et al. 2017). The concurrent and interconnected challenges of the triple burden of malnutrition and climate change described above have been referred to as the Global Syndemic (Swinburn et al. 2019).

2.2 **Policy responses**

2.2.1 **Development policy is broadening its focus to consider the multiple aspects of food systems.**

In response to these challenges, the international community has refocused efforts to tackle malnutrition in recent years, with the number of interventions implemented and studied increasing substantially and taking place in multiple stages of the food system. Governments are increasing their spending on nutrition-sensitive interventions and developing nutrition targets (Development Initiatives 2020). Diverse new regulations have been implemented regarding the labelling and marketing of food in many countries (Zhang et al. 2014).

Furthermore, behaviour change programmes have expanded drastically in recent years (Section 4). These include education and social support efforts for infant- and young child-feeding; healthy, culturally appropriate food options; and meal planning. Although nutrition-specific interventions have immediate effects on child malnutrition, the effects of these nutrition-sensitive programmes may be longer term and more sustainable (Khalid et al. 2019).

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2 For example, see Ruel et al. 2018; USAID 2019; Majamanda et al. 2014; or Fiorella et al. 2019.
2.2.2 Efforts to coordinate policy and research in the sector exist, but recent increases in funding are not sufficient to address future malnutrition issues.

Several initiatives aim to coordinate and inform efforts across different sectors and research. For example, the UN initiated the Scaling-up Nutrition Movement to stimulate an international recommitment to fighting hunger. Similarly, the Global Alliance for Improved Nutrition seeks to build alliances between governments, businesses and civil society to find and deliver solutions to end malnutrition. The EAT-Lancet Commission has developed scientific targets for achieving a healthy diet and sustainable food production by 2050. Another set of targets has been developed by the World Health Assembly with a specific goal of aligning these targets with the SDGs (WHO 2018). In addition, the High Level Panel of Experts on food security and nutrition facilitates policy debates and provides evidence-based advice at the request of the UN Committee on World Food Security.

Significant increases in funding have accompanied these new efforts. For example, funding for basic nutrition interventions increased from slightly under USD200 million in 2006 to over USD900 million in 2013 (World Bank 2017). Additionally, 8 of the top 10 donors supporting nutrition-specific interventions (as aligned with the World Health Assembly targets) increased their funding between 2015 and 2017 (R4D 2019). The most active donors are largely governmental (the UK, the US and the European Union), with some non-governmental organisations and foundations also donating significant amounts, such as the International Development Association and the Bill & Melinda Gates Foundation (R4D 2019).

Yet this increased level of funding is still less than the estimated resources needed (R4D 2019), with nutrition accounting for less than 1 per cent of the official development assistance budget globally in 2016 (Development Initiatives 2018). The result is also true for domestic spending, as available data suggest that spending on high-impact nutrition interventions is not at the required level, although limited data availability makes it challenging to fully assess domestic spending (Development Initiatives 2020).

Several attempts have been made to estimate the funding gap in the sector. For example, the Ceres2030 initiative suggests that between 2018 and 2030, donors need to contribute an additional USD14 billion per year, complemented with USD19 billion from L&MIC governments per year, to end hunger and double farmer incomes while curtailing greenhouse gas emissions (Laborde et al. 2020). In addition, the World Bank (2017) projected that if an additional USD70 billion was made available between 2015 and 2025, 65 million cases of stunting and 265 million cases of anaemia in women could be avoided.

2.3 Why is this EGM important?

The complexity of implementing food systems interventions in L&MIC settings and the considerable size and range of current research can hinder evidence-informed nutrition programmes and policies. This map seeks to increase evidence discoverability and use.

Food systems, environmental sustainability, health and nutrition are intrinsically linked, and food systems programming with nutrition-related aims can benefit from coordinated efforts across multiple sectors, including the food supply chain (Ruel et al. 2018). This
map reports on evidence from all key areas and intervention types within the food system to inform comprehensive policy.

The extensive literature examining the effects of food systems interventions on food security and nutrition in L&MICs can also overwhelm decision makers. As an example, preliminary searches of the 3ie Development Evidence Portal (used to inform the design of our project) suggested over 1,000 impact evaluations and 45 systematic reviews of potentially relevant interventions that were completed or ongoing since 2008. A recent review of nutrition-sensitive evidence also found that the body of evidence related to nutrition-sensitive agriculture increased in size since 2014 by 44 studies (Ruel et al. 2018).

There are existing systematic reviews and EGMs on topics related to food systems; for example, efforts to map existing metrics for measuring the functioning of food systems (Sparling et al. 2019), the sustainability of food systems (Béné et al. 2019), the state of food systems in certain countries (de Brauw et al. 2019), and the funding landscape (World Bank 2017). This study aims to build on these previous efforts by providing a comprehensive overview of all the available high-quality systematic review and impact evaluation evidence on the effects of food systems interventions on food security and nutrition outcomes since 2000.

Mapping the evidence from impact evaluations and systematic reviews across all sectors of the food system makes this research more accessible. In addition, this mapping can inform future research investments; for example by clearly identifying absolute gaps (no or very few impact evaluations) or synthesis gaps (clusters of impact evaluations and no high-quality systematic review) with respect to specific interventions and/or outcomes.

3. Scope and methods

3.1 Conceptual framework

The High Level Panel of Experts developed a framework to systematically map food systems (HLPE 2017), and in 2019 the International Food Policy Research Institute extended this framework to include additional feedback mechanisms (de Brauw et al. 2019). This extended framework was adopted as the conceptual basis of our efforts to map the evidence relating food systems to nutrition and food security.

The framework suggests three intervention domains within the food system: the food supply chain, the food environment and consumer behaviour. The domains reflect types of actions and interventions, not a sequential flow of activities leading to one another. The food supply chain is broken down into production activities, storage and distribution, processing and packaging, and food loss and waste management, as shown in Figure 1.

The food environment is the physical, economic, political and sociocultural surroundings, opportunities and conditions that create, prompt and shape dietary preferences and choices and nutritional status (Swinburn et al. 2014; Global Panel 2017). These include the availability, physical accessibility and provision of foods; affordability; promotion and labelling; and food quality and safety. Finally, consumer behaviour involves individual preferences related to consumption, food prices and income available for food (de Brauw et al. 2019). It includes prices, preferences, women's empowerment in the context of the food system, and information.
The framework outlines five main drivers of change in (global) food systems: biophysical and environmental; innovation, technology and infrastructure; political and economic; sociocultural; and demographics (HLPE 2017). These drivers work outside; however, they have significant impacts on food systems by altering food production and demand. The framework also considers outcomes related to food security and diet, and ultimate outcomes related to nutrition; health; and social, economic and environmental well-being.

**Figure 1: EGM scope summary**

Source: 3ie 2020; adapted from HLPE 2017.

Note: The bi-directional arrows seek to highlight that intervening at one stage in the food system may have implications for activities at another stage.

### 3.2 Criteria for including and excluding studies

When defining the scope of relevant interventions and outcomes, the aim was to be as comprehensive as possible whilst setting a feasible scope that was not too broad to be presented in a visually appealing and interpretable manner. Table 2 presents the detailed criteria for including and excluding studies according to the population, intervention, comparator, outcome and study design (PICOS) framework. In summary, it sought to identify systematic reviews of effectiveness and quantitative impact evaluations that assessed the effects of at least one food system intervention on food security and nutrition outcomes for any population based in an L&MIC.

An impact evaluation was defined as a study that uses rigorous methods to provide a quantitative estimate of the impact of an intervention. This is accomplished by constructing a counterfactual, which provides evidence about what would have happened in the absence of the intervention. In an impact evaluation, the outcomes of those who receive the intervention are compared with those of a comparison group that does not receive the intervention.

The comparison group may be a specific population in the study area that does not receive the treatment (as in a randomised controlled trial) or may be constructed by researchers (as in propensity score matching or interrupted time series). For an impact evaluation to be valid, there must be a sound statistical basis for claiming that the comparison group represents what would have happened to the treatment group had they not received the intervention.
A systematic review was defined as a synthesis of the research evidence on a particular topic (e.g. the effectiveness of water supply and sanitation) obtained through an exhaustive systematic literature search for all relevant studies using widely accepted scientific strategies to minimise error associated with appraising the design and results of studies.

### 3.3 Search strategy

A systematic search of 12 academic bibliographic databases was completed in May 2020 to identify qualifying studies. Additional studies identified before the end of September 2020 were also included. To address potential publication bias issues, the following data sources were used:

- **Other specialist databases and websites**: In total, 31 sector-specific databases and websites were searched. Basic search strings were used where search functionality was limited.
- **Backward citation tracking**: Citations for all included systematic reviews were reviewed for inclusion.
- **Communication with researchers**: Information about potential eligible studies up to the end of September 2020 were requested. This occurred through two main channels: (1) engaging with the project advisory and policy stakeholder groups; and (2) publishing a call for information via a related blog post on the 3ie website and promoting it using social media.

#### Table 2: PICOS summary of criteria for the inclusion and exclusion of studies

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Inclusion criteria</th>
<th>Exclusion criteria</th>
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</thead>
</table>
| **Population**   | ▪ Programme participants that were located in a L&MIC in the first year of implementation\(^3\)  
▪ Impact evaluations with at least one effect size for an L&MIC country population  
▪ Studies focused on the prevention of clinical conditions          | ▪ Studies focused on niche populations, such as athletes or the military  
▪ Efficacy studies, unless they were completed in a sufficiently real-world setting  
▪ Studies targeting participants with a clinical condition  
▪ Studies focused on high-income country migrant populations in L&MICs and vice versa |
| **Intervention** | ▪ Interventions that directly intervene on an aspect of the food system within its three primary domains: the food supply chain, the food environment and consumer behaviour  
▪ Studies evaluating multiple food systems interventions | ▪ Interventions not in the food system or interventions targeting drivers of the food system without an explicit food system focus  
▪ Unconditional cash transfer programmes  
▪ Interventions focused on the financing of a food systems intervention |

| Comparisons | • Appropriate comparisons included: business as usual, an alternative treatment, no treatment or an early-versus-late comparison (where those that took part in earlier years are compared to those that took part in later years) | • Studies that did not justify and make use of an appropriate comparison group |
| Outcomes | • Final outcomes relating to anthropometry, physical and mental development outcomes, micronutrient status, diet quality and adequacy, food safety affordability and availability | • Health and non-food-system related education outcomes • Mortality and morbidity outcomes, unless a disease is directly linked to a specific micronutrient deficiency (e.g. anaemia or goitre) |
| Study design | • Effectiveness studies, based in real-world settings, employing one of the following methods: randomised controlled trials (where treatment assignment is random); and quasi-experimental designs (where treatment is assigned as if it were random; e.g. regression discontinuity design, instrumental variables, panel methods, difference-indifference, synthetic control groups, interrupted time series analysis and statistical matching) • Systematic effectiveness reviews, which employ recognised search and synthesis methods (Snilstveit et al. 2016) | • Before-after studies or cross-sectional studies that do not attempt to control for selection bias or confounding in any way • Case-control studies • Randomised block designs where farm field sections are the blocking unit • Willingness-to-pay and hypothetical experiment studies |
| Other | • Studies published in or after the year 2000 • Complete or ongoing studies (i.e. protocols are included) • Studies in any publication format | • Studies in any language other than English |

Source: 3ie 2020.
Note: The cutoff at the year 2000 was made arbitrarily to make the volume of search results more manageable.
3.4 Screening

Screening of studies was managed using EPPI-Reviewer 4 software\(^4\) (Thomas et al. 2010) and was completed by implementing the following steps:

- **Prepare study records:** All output files of the implemented search strategy were imported into EPPI-Reviewer software. Studies that were identified through the additional means specified were added to the software manually. An automated process within the software was used to remove duplicate files.

- **Title and abstract screening:** The title and abstracts of all imported and de-duplicated studies were single screened. The screener assigned one code, which indicated that either the study should be included for full-text screening, that the study should be excluded or that they were unsure. If a study was excluded, the reviewer coded the rationale for exclusion. Where screeners had any difficulty in applying the eligibility criteria, a study was screened by a second reviewer, in what is known as a safety-first approach. Periodic meetings were also held to discuss and resolve screening decisions for studies that screeners had coded as ‘unsure’. EPPI-Reviewer 4 software’s machine learning capabilities were used to streamline the process and efficiently remove clearly irrelevant studies.

- **Full text screening:** The full text was retrieved for each study that met all the title and/or abstract inclusion criteria. Initially, two reviewers examined each full text in detail against the protocol and applied a code to indicate whether the study was included or why the study was excluded. Disagreements were reconciled periodically. From August 2020, full texts were single screened with safety first due to time constraints. Overall, 30 per cent of studies included at the title and abstract stage were double screened. This process identified a set of studies coded as meeting eligibility criteria.

- **Checks for linked publications:** Publications were linked where the analysis was based on data related to the same study population. This typically occurred when authors followed a group of participants over time, published multiple versions of the same study in different formats (e.g. a working paper later published as a journal article) or updated a systematic review. Descriptive information was only included once for each group of linked publications, so that each study was independent. This means that the presented analysis is reported at the study level, rather than the publication level.

3.5 Data extraction and analysis

Data were systematically extracted from all included studies using the data extraction tool described in Appendix D. Extracted data covered the following:

- **Study characteristics:** This coding focused on capturing the general characteristics of the study, including authors, publication date and status, study location and setting, intervention type, outcomes reported, definition of outcome measures, population of interest, and study and programme funder. Methodological information was also collected, covering the type of quantitative methods employed and whether authors complemented quantitative results with qualitative results and/or conducted any cost or cost-benefit analyses.

• **Critical appraisal (systematic reviews only):** All systematic reviews were appraised following the practices adopted by 3ie systematic review database protocol, which draws on Lewin and colleagues (2009). This process involved appraising each review’s search, screening, risk of bias assessment, data extraction and synthesis. Each systematic review was rated as low, medium or high confidence, drawing on guidance provided in Snilstveit and colleagues (2017). Initially, a 5 per cent sample of reviews was appraised by two researchers, then independently reconciled by a systematic review expert. Reviewers were provided with feedback, and reliability was judged to be sufficient. Subsequently, one person appraised each systematic review, and the systematic review expert independently reviewed all completed appraisals. Impact evaluations were not critically appraised, as this is typically beyond the scope of an EGM.

Descriptive analysis was completed to directly answer the key research questions of the project. In some areas, more detailed cross-cutting analysis and comparisons to other data sources are presented.

### 3.6 Presentation of the map

Results are presented graphically on an interactive online platform. The main framework is a matrix of interventions and outcomes, with grey and coloured circles representing impact evaluations and systematic reviews. The systematic reviews follow a traffic-light system to indicate confidence in their findings: green for high, orange for medium, red for low. The colour blue indicates that the study is ongoing. The size of the bubble indicates the relative size of the evidence base for that intersection of intervention and outcome. The interactive aspect of the EGM allows users to filter the results based on key variables, thereby facilitating efficient, user-friendly identification of relevant evidence. The filters and their definitions are provided in Table 3.

#### Table 3: Study characteristics for EGM filtering

<table>
<thead>
<tr>
<th>Filter</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Region</td>
<td>The relevant continent or region in which the intervention took place</td>
</tr>
<tr>
<td>Country</td>
<td>The country in which the intervention took place</td>
</tr>
<tr>
<td>Sex</td>
<td>The sex of the sample for which impact is estimated or the intervention broadly targets</td>
</tr>
<tr>
<td>Age</td>
<td>The age group of the sample for which impact is estimated or the intervention broadly targets</td>
</tr>
<tr>
<td>Setting</td>
<td>The setting where the sample population was primarily located and administered</td>
</tr>
<tr>
<td>Study design</td>
<td>The quantitative experimental or quasi-experimental design implemented to estimate effects</td>
</tr>
<tr>
<td>Mixed methods</td>
<td>Whether qualitative evidence was analysed to complement quantitative results</td>
</tr>
<tr>
<td>Cost evidence</td>
<td>Whether and what cost data was reported for the intervention</td>
</tr>
</tbody>
</table>

Source: 3ie 2020.

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5 Available at: [https://www.3ieimpact.org/evidence-hub/evidence-gap-maps](https://www.3ieimpact.org/evidence-hub/evidence-gap-maps) [Accessed 28 October 2020].
3.7 Study strengths and limitations

The study has the following strengths:

- **Current**: At the time of reporting, this map provides the most up-to-date characterisation of the available evidence of the effects of food systems interventions on food security and nutrition outcomes.
- **Timely**: This map was commissioned in response to a direct policy need, and the review protocol was developed and implemented in a nine-month period, drawing on the latest advances in synthesis project management.
- **Broad**: The scope of the map is broad. Outcome information was also collected for a range of intermediate outcomes reported in studies.

The following limitations can be applied to this study:

- **No forward citation checking**: Due to the high volume of included studies, it was not feasible to screen records that cited included studies.
- **Focused data extraction**: Comprehensive characteristics relating to study equity considerations and research transparency were not extracted at this stage due to time constraints. However, these characteristics will be extracted and uploaded to our 3ie Development Evidence Portal in due course.
- **English language focus**: Studies only published in non-English languages were missed, which may introduce bias. However, research has found that synthesis results are not affected when the effect sizes from non-English studies are removed from the analysis (Higgins et al. 2019).
- **Time-bound**: This map only considered works published up until May 2020, with additional studies identified by the study team being permitted into the map until September 2020. It is planned to keep this map updated through our living Development Evidence Portal. However, some of the methodological approaches to updates are still being established.
- **Quality of impact evaluations not reviewed**: The standard analytical procedure for an EGM is to appraise the quality of systematic reviews but not impact evaluations. While the impact evaluations included meet our eligibility criteria, the quality of the evaluation specification or design (e.g. through an assessment of the theory of change or the completion of a risk of bias assessment) was not appraised.

4. Results

This section presents the EGM’s key findings, summarising the search results and included studies. It draws on metadata captured during screening and descriptive information extracted from studies. Definitions of interventions and outcomes in this framework are presented in Appendix A.

4.1 Results of the search

The electronic searching of academic databases produced a total of 142,849 records, and non-electronic searching and citation tracking identified a further 1,590 (resulting in 144,439 total records for screening). After removing 32,798 duplicate records, screeners used title and abstract information only to screen 111,641 study records against the eligibility criteria. At this stage, studies were mainly excluded for not focusing on a
relevant intervention and/or not being an impact evaluation. This screening identified 10,320 records as potentially relevant. Finally, screeners conducted a full-text review of these studies and identified 2,503 total records that met all eligibility criteria and were included in the review. These records corresponded to 2,035 unique studies. A summary of this process is presented in Figure 2.

**Figure 2: Overview of search and screening process**

Source: 3ie 2020. Analysis of review search results.

Note: citation records for 1,620 studies were identified; when attempting to find the full text, there was no online record. SR = systematic review; IE = impact evaluation.

### 4.2 Characteristics of the evidence base

The remainder of this section provides a descriptive overview of the distribution of studies using the PICOS characteristics described in Section 3. A tabular breakdown of the Figures presented is provided in Appendix E.
4.2.1 Size of the evidence base

Since 2000, the total number of impact evaluations and systematic reviews has increased more than a hundredfold, with increases especially high for evaluations of food supply chain and consumer behaviour interventions.

Since 2000, the number of published studies evaluating and reviewing relevant interventions has increased, with the number of known reviews meeting the inclusion criteria increasing from 0 to 178 (with 3 still ongoing) and impact evaluations increasing from 17 to 1,838, with just over 100 still ongoing (Figure 3).

Figure 3: Cumulative distribution of included studies by publication year

The rate of evidence production has also increased, with half of all impact evaluations published between 2015 and 2019. This growth in research occurred across all domains but is largely due to an increased number of studies evaluating food supply chain and consumer behaviour interventions (Figure 4), with the associated research areas growing by more than tenfold between 2000 and 2019. However, the increase in studies evaluating food environment interventions was not as large (threelfold during the period).

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6 From Figure 4, we consider the change in the number of studies published between 2000–2004 and 2015–2019: food supply chain 430/33 = 13.0; food environment 260/79 = 3.3; consumer behaviour 288/22 = 13.1.
Figure 4: Proportion of intervention domains evaluated in impact evaluations over time

Source: 3ie 2020. Analysis of interventions evaluated in 1,854 impact evaluations.
Note: If a study evaluated multiple interventions, the study was counted multiple times.

4.2.2 Intervention coverage
Most interventions were examined by at least one impact evaluation, and all interventions with at least 50 evaluations were synthesised by at least one systematic review.7

The most common interventions were nutrition specific: provision of supplements (SR: n = 67; IE: n = 369), fortification (SR: n = 42; IE: n = 285), classes in the consumer behaviour domain (SR: n = 23; IE: n = 245), direct provision of foods (SR: n = 24; IE: n = 205), and peer support and counselling in the consumer behaviour domain (SR: n = 22; IE: n = 130), as shown in Figure 5. Classes and educational interventions throughout the food system were considered. Most common were classes that targeted consumer behaviour, as opposed to agricultural practices or other factors. These classes were often related to infant and young child feeding practices, but included a range of other topics, such as cooking classes, making healthy purchases and basic nutrition information.

Some evidence gaps exist.
No impact evaluations were identified that examined interventions related to advertising regulations, food waste education programmes or the direct packaging of food. Several intervention categories had fewer than five studies: food safety regulations (n = 1), cold chain initiatives (n = 1), composting education (n = 3), labelling regulations (n = 3), private food donation (n = 3), door-to-door behaviour change communication campaigns (n = 4), provision of goods and/or services to support food processing (n = 4), on-farm and post-harvest processing (n = 4), and access to pesticides (n = 4).

7 Systematic review is referred to as SR and impact evaluation as IE in subsections 4.2 and 4.3.
There were also several interventions associated with multiple impact evaluations but with only one or no systematic reviews. The categories with the most impact evaluations were: *agricultural extension* (SR: n = 1; IE: n = 112), *agricultural inputs – other* (SR: n = 1; IE: n = 65), *agricultural information provision* (SR: n = 0; IE: n = 27), *government manipulations of price* (SR: n = 1; IE: n = 22) and *agricultural insurance* (SR: n = 1; IE: n = 22).

**Figure 5: Distribution of included studies by intervention domain and subdomain**

Source: 3ie 2020. Analysis of interventions evaluated in 1,838 impact evaluations and 178 systematic reviews.

Note: If a study evaluated multiple interventions, the study was counted multiple times. Note: MC stands for multiple-component interventions.
Several impact evaluations evaluated programmes with components from across the food system, and most of these included at least one food supply chain intervention.

In total, 11 impact evaluations considered programmes with at least 5 intervention categories from the underlying food system framework, and 8 systematic reviews considered a broad range of interventions. All except one of these evaluated programmes included at least one food supply chain intervention, and six were entirely composed of different food supply chain interventions. For example, in the work of Nyyssölä and colleagues (2012), the evaluated programme provided a range of support to improve food security, including creating and training groups of farmers, setting up demonstration farms and providing a range of agricultural inputs.

Studies that evaluated common combinations of interventions were grouped together. Common combinations found in the data are shown in Table 4. In total, 69 studies were grouped into 10 different multiple-component interventions. The most common combinations of food systems interventions identified were classes within the consumer behaviour domain and healthy eating campaigns (n = 11), peer support/counselling and these classes (n = 9), and fortification and direct provision of food (n = 9).

Table 4: Most commonly evaluated multiple-component food systems interventions

<table>
<thead>
<tr>
<th>Multiple-component intervention</th>
<th>No. of SRs</th>
<th>No. of IEs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large multiple-component interventions</td>
<td>8</td>
<td>11</td>
</tr>
<tr>
<td>Classes and healthy food campaigns</td>
<td>1</td>
<td>11</td>
</tr>
<tr>
<td>Peer support / counselling and classes</td>
<td>0</td>
<td>9</td>
</tr>
<tr>
<td>Fortification and direct provision of food</td>
<td>0</td>
<td>9</td>
</tr>
<tr>
<td>Provision of seeds and farmer field schools</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>Peer support / counselling and community meetings</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>Direct provision of foods and peer support</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>Professional services and classes</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Direct provision of foods and classes</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>Provision of supplements and classes</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Education / information - other educational programmes and classes</td>
<td>0</td>
<td>5</td>
</tr>
</tbody>
</table>

Source: 3ie 2020. Analysis of interventions evaluated in 1,838 impact evaluations and 178 systematic reviews.

Notes: All classes relate to those in the consumer behaviour domain. Any intervention that evaluated more than five separate intervention codes from the underlying framework was recorded as a large multiple-component intervention. This threshold of five codes was selected arbitrarily.

4.2.3 Outcome coverage

The screening classified outcomes into thematic categories and as either intermediate or final outcomes. Final outcomes involve ultimate consumer food security, physical and/or mental development and nutrition outcomes, while intermediate outcomes involve preceding causal steps in the theories of change. First, the distribution of outcomes by thematic category was considered, followed by intermediate and final type.
The most common final outcome categories were anthropometric, micronutrient status, and diet quality and adequacy outcomes. Almost three quarters of studies included at least one final outcome effect size (SR: n = 170; IE: n = 1,353). As shown in Figure 6, the most common outcomes were: anthropometric (SR: n = 111; IE: n = 671); focused on diet quality and adequacy (SR: n = 51; IE: n = 555), micronutrient status (SR: n = 78; IE: n = 530), iron (SR: n = 66; IE: n = 395), vitamin A (SR: n = 24; IE: n = 119), zinc (SR: n = 24; IE: n = 102) and iodine (SR: n = 5; IE: n = 24) status; concerned with other developmental outcomes (SR: n = 31; IE: n = 144); and focused on food affordability and availability (SR: n = 10; IE: n = 102) (Figure 6). Relatively few studies reported effects for food safety outcomes (SR: n = 1; IE: n = 34), of which the majority related to food-borne illness (n = 26).

Figure 6: Outcome category frequency by outcome type

Source: 3ie 2020. Analysis of interventions evaluated in 1,838 impact evaluations and 178 systematic reviews.
Notes: If a study evaluated multiple outcomes, the study was counted multiple times. This means that the total number of studies reported here is higher than the actual number of studies included in the map.

These indicators were highly variable. The most commonly considered outcomes were related to breastfeeding and dietary diversity. However, there was a large ‘others’ category that was dominated by reporting on the consumption of specific foods or categories of foods, as would be seen in a food frequency questionnaire. Very few studies considered whether diets met specific, predetermined quality metrics, such as if a recommended dietary allowance was met.
The most common intermediate outcome categories were economic, agricultural and intrinsic motivational outcomes.

Final outcomes relate to the final set of food security and nutrition outcomes of interest to this map. Intermediate outcomes reflect the range of expected causal steps in the theories of change underpinning food systems interventions; for example, outcomes related to changes in economic or agricultural activities or changes in the knowledge, perceptions or preferences of individuals, which were referred to collectively as intrinsic motivators in our framework.

Fewer studies examined intermediate outcomes, with just under half of all studies reporting at least one effect size for an intermediate outcome (SR: n = 38; IE: n = 848) (Figure 7). Studies were most likely to include economic outcomes (SR: n = 18; IE: n = 350) such as income and the value of agricultural output, the ownership of assets, food prices or purchasing behaviour; agricultural outcomes (SR: n = 13; IE: n = 309) that relate to the quality and scale of agricultural crop and livestock production; indicators measuring intrinsic motivators (SR: n = 16; IE: n = 302); and measures of behaviour change (SR: n = 15; IE: n = 269), such as the observed adoption of recommended agricultural or breastfeeding behaviours. Several intermediate outcomes were measured in fewer than five studies, including: economic, social and political stability; regulations; food loss; environmental impacts of the food system; food distribution; and advertising and labelling.

The most common final impact evaluation outcomes were linear growth, iron status, weight and relative weight; the most common intermediate outcomes were behaviour change, knowledge, income and plant production.

To illustrate the specific outcomes examined in impact evaluations, Figure 7 reports the most common measures by outcome type. Anthropometric outcomes were commonly measured using linear growth, weight and/or relative weight.
The data identified several outcome gaps related to food access, safety and affordability, as well as a few understudied intermediate outcomes. Several final outcomes were evaluated in fewer than five studies: location of foods in stores; climate impact; non-food waste produced; import/export; agricultural cooperative performance; women’s self-esteem; food spoilage or loss; and economic, social and political stability. (Table 5 lists all the least-common outcomes evaluated by included studies.)
Table 5: Least-common outcomes evaluated by impact evaluations in the evidence base

<table>
<thead>
<tr>
<th>Intermediate Outcome</th>
<th>No.</th>
<th>Final Outcome</th>
<th>No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food toxins</td>
<td>2</td>
<td>Location of foods in stores</td>
<td>1</td>
</tr>
<tr>
<td>Other food safety outcome</td>
<td>6</td>
<td>Climate impact</td>
<td>1</td>
</tr>
<tr>
<td>Food access</td>
<td>9</td>
<td>Non-food waste produced</td>
<td>1</td>
</tr>
<tr>
<td>Physical development</td>
<td>9</td>
<td>Import/export</td>
<td>2</td>
</tr>
<tr>
<td>Food affordability</td>
<td>12</td>
<td>Agricultural cooperative performance</td>
<td>2</td>
</tr>
<tr>
<td>Food availability &amp; supply</td>
<td>12</td>
<td>Women’s self-esteem</td>
<td>2</td>
</tr>
<tr>
<td>Other food security outcome</td>
<td>13</td>
<td>Food spoilage or loss</td>
<td>3</td>
</tr>
<tr>
<td>Iodine micronutrient status</td>
<td>24</td>
<td>Ecological, social &amp; political stability</td>
<td>3</td>
</tr>
<tr>
<td>Insufficient diet</td>
<td>25</td>
<td>Water-related</td>
<td>9</td>
</tr>
<tr>
<td>Food-borne illness</td>
<td>26</td>
<td>Women’s ownership of assets</td>
<td>11</td>
</tr>
<tr>
<td>Food insecurity measures</td>
<td>72</td>
<td>Women’s control of resources</td>
<td>11</td>
</tr>
</tbody>
</table>

Source: 3ie 2020. Analysis of interventions evaluated in 1,838 impact evaluations.
Note: If a study evaluated multiple outcomes, the study was counted multiple times. This means that the total number of studies reported here is higher than the actual number of studies included in the map.

Most studies evaluated only final outcomes, but increasingly studies have considered intermediate outcomes.

Studies that only evaluated final outcomes accounted for just over half the evidence base (n = 990; 54%), while just over a quarter of studies considered intermediate outcomes only (n = 485), and one fifth considered both intermediate and final outcomes (n = 363), as shown in Panel A of Figure 8, below. That said, the proportion of studies that only measured intermediate outcomes, and both types of outcome, increased between 2000 and 2019 (Panel B), from 12 to 297 studies and 9 to 215 studies, respectively. In particular, there was an increase in the number of studies only considering intermediate outcomes that evaluated food supply chain interventions; namely, extension programmes and farmer field schools. In the case of studies evaluating both intermediate and final outcomes, the increase shown in Panel B is mainly due to an increase in studies evaluating information and behaviour change interventions.
Figure 8: Disaggregation of outcomes by intermediate and final categories and publication year

Source: 3ie 2020. Analysis of interventions evaluated in 1,838 impact evaluations.

4.2.4 Country coverage
Geographical data was collected on countries where studies were conducted, with additional analysis of country income and fragile and conflict-affected country status, both as defined by the World Bank.

A plurality of impact evaluations were located in Sub-Saharan Africa, lower middle-income countries and countries without fragility issues.
Overall, the findings showed the following results with respect to the geographic locality of studies:
- **Region**: Impact evaluations were most commonly located in Sub-Saharan Africa (n = 648; 33%), followed by South Asia (n = 367; 20%), and East Asia and the Pacific (n = 324; 17%), as shown in Figure 9.

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- **Income level:** Roughly a quarter of studies were conducted in low-income countries (n = 485), as defined by the year of publication, while approximately 40 per cent took place in lower middle-income countries (n = 792), and just over one third took place in upper-middle income countries (n = 627).

- **Fragility setting:** Seven per cent of studies were conducted in fragile contexts (n = 130).

- **Multi-country studies:** A subset of 33 studies reported effects across multiple countries (99 country effects).

Highly populated countries were the most common study locations.
The greatest number of impact evaluations took place in India (n = 176; 9%), Bangladesh (n = 116; 6%), China (n = 115; 6%), Brazil (n = 105; 6%) and Iran (n = 96; 5%), as shown in Figure 9. When broken down by region, Table 6 shows the top three countries associated with the most studies.

**Table 6: Overview of countries with the most impact evaluations by region**

<table>
<thead>
<tr>
<th>Region / rank</th>
<th>Country with most studies</th>
<th>Country with second-most studies</th>
<th>Country with third-most studies</th>
</tr>
</thead>
<tbody>
<tr>
<td>East Asia and the Pacific</td>
<td>China (n = 115)</td>
<td>Indonesia (n = 48)</td>
<td>Vietnam (n = 42)</td>
</tr>
<tr>
<td>Europe and Central Asia</td>
<td>Turkey (n = 20)</td>
<td>Belarus (n = 5)</td>
<td>Albania (n = 3)</td>
</tr>
<tr>
<td>Latin America and Caribbean</td>
<td>Brazil (n = 105)</td>
<td>Mexico (n = 80)</td>
<td>Peru (n = 21)</td>
</tr>
<tr>
<td>Middle East and North Africa</td>
<td>Iran (n = 96)</td>
<td>Morocco (n = 7)</td>
<td>Egypt (n = 7)</td>
</tr>
<tr>
<td>South Asia</td>
<td>India (n = 176)</td>
<td>Bangladesh (n = 116)</td>
<td>Nepal (n = 35)</td>
</tr>
<tr>
<td>Sub-Saharan Africa</td>
<td>Kenya (n = 81)</td>
<td>Ethiopia (n = 75)</td>
<td>Ghana (n = 56)</td>
</tr>
</tbody>
</table>

Source: 3ie 2020. Descriptive analysis of data extracted from 1,838 included impact evaluations, which included 1,904 evaluations in total once multi-country studies were accounted for.
Similar types of interventions were implemented in each region, although there were some variations for the Sub-Saharan Africa and Latin America regions. In Sub-Saharan Africa, a relatively larger proportion of interventions resided within the production system (n = 300) compared to the other regions. In the case of Latin America, studies evaluating at least one food environment intervention were most prevalent (n = 136), especially provision or use of supplements (n = 69), cash-for-food programmes and direct provision of food (both n = 35).

Impact evaluations have been conducted in most fragile states; the interventions evaluated in fragile states are somewhat similar to interventions evaluated in all L&MICs.
In total, 130 separate country evaluations (reported in 128 studies) were conducted in countries classified as fragile. Most of these studies took place in Sub-Saharan Africa (n = 87) and the Middle East and North Africa (n = 15), the two regions with the most fragile states. In these two regions, 58 per cent of all fragile and conflict-affected countries had at least one impact evaluation. The fragile states where evaluations most commonly took place were Mali (n = 22), Mozambique (n = 17) and the Democratic Republic of Congo (n = 16). Some fragile and conflict-affected countries had no studies conducted.11 In total, the included studies covered 25 of the world’s 36 fragile countries.

11 These were Djibouti, Central African Republic, Comoros, Congo, Eritrea, Afghanistan, Papa New Guinea, Tuvalu, Kiribati, Solomon Islands and Micronesia.
The distribution of interventions studied in fragile studies broadly matched that of non-fragile states, with some differences. For example, the most common interventions evaluated in fragile states were the provision of supplements, direct provision of food and provision of new and/or improved seed varieties, rather than the provision of supplements, fortification and classes in the consumer behaviour domain, as described above.

The distribution of outcomes assessed in fragile states also broadly aligns with those measured in studies not located in fragile states, although relatively more studies considered food insecurity (4% versus 12%), behaviour change (14% versus 21%) and knowledge (13% versus 19%) in fragile states. In terms of population and study characteristics, some minor differences were found between studies located in fragile and non-fragile states. Studies in fragile states included fewer local (69% versus 77%) and more transnational (9% versus 1%) studies, and focused less on adults (26% versus 15%) and more on children aged 5–9 years (12% versus 18%).

4.2.5 Population and setting coverage
Data was extracted regarding study participants, the scale of implementation and where interventions were administered.

Impact evaluations mostly targeted both sexes and people of diverse ages, except those over 60.
Most studies included both sexes (n = 1,055; 59%) or did not specify sex targets (n = 338; 19%). Ten studies specifically targeted males (1%), while 364 studies targeted females (20%). Of the 65 per cent of studies that reported participant age information (Figure 10, Panel A), children under the age of 2 comprised the most prevalent age bracket (n = 497; 19%), closely followed by adults aged 20–59 (n = 466; 18%) and adolescents aged 10–19 (n = 440; 17%). Relatively few studies assessed intervention effectiveness for older populations (n = 59; 2%).
Figure 10: Distribution of impact evaluations by age and reproductive cycle targeting

![Bar chart A: Age (years) distribution](image)

- Not specified
- > 60
- 20–59
- 10–19
- 5–9
- 2–4
- < 2

![Bar chart B: Reproductive state](image)

- Premenarchal women and girls
- Postmenopausal women
- Lactating
- Postpartum
- Pregnant

Source: 3ie (2020). Descriptive analysis of data extracted from 1,838 included impact evaluations.

Notes: Multi-coding was permitted for age and reproductive state. If a study provided information on the age group it was targeting or it presented baseline information of the average age of participants, this was coded using the framework presented in Figure 10. Where age brackets used by authors overlapped with more than one bracket used in this EGM, age was multi-coded.

Of the roughly 25 per cent of evaluations that targeted women at a specific stage in the reproductive cycle (n = 405), the most common stages were pregnancy (n = 214; 53%), postpartum (n = 86; 21%) and lactating women (n = 68; 17%), as shown in Figure 10, Panel B. Among the studies that targeted infants, 14 per cent (n = 69) also targeted pregnant, lactating or postpartum women.

**Over half of interventions were conducted in rural areas.**

In terms of the locality in which impact evaluations were set, just over half of all studies were set in rural areas (n = 956; 52%), one fifth were in urban areas (n = 379; 21%), and the remainder (where locality was specified) were set in both rural and urban or peri-urban areas (both: n = 107, 6%; peri-urban: n = 49, 3%).

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Most evaluated interventions were local in scale, and households were the most common setting. Roughly 84 per cent of studies focused on evaluating programmes set entirely in a local area (n = 1,401) – that is, within a regional administrative unit of the country in question. This suggests that few studies were focused on the evaluation of scale-up programmes. Of the studies that evaluated programmes at a national (n = 141) or transnational level (n = 34), the most common interventions were cash-for-food programmes (n = 28), direct provision of food (n = 18), agricultural extension programmes (n = 12), providing access to improved seed varieties (n = 11) and provision of supplements (n = 11).

Figure 11: Distribution of studies by scale of implementation and study setting

In terms of where interventions were administered, we found that a plurality of studies took place in households (n = 627; 33%). There was similar coverage across the next three categories (schools: n = 351, 19%; businesses: n = 334, 18%; communities: n = 400, 21%), with roughly one tenth of interventions administered in hospitals (n = 191; 10%).

Source: 3ie (2020). Descriptive analysis of data extracted from 1,838 included impact evaluations. Note: In the case of panel B, multi-coding was permitted.
4.2.6 Funding for programmes and impact evaluations

Over 1,300 (59%) studies did not specify the programme funding agency type or name. When funding was specified, we found that it was most commonly attributed to government agencies, who were listed as programme funders in 403 (18%) studies, followed by non-profit organisations (n = 126; 6%), international aid agencies (n = 108; 5%), and charitable or private foundations (n = 101; 4%) (Figure 12). Few studies specified programmes funded by for-profit firms and international financial institutions (2%, ), although these organisations might have actively financed programmes where funding was not specified.

Looking at research funders, we found a similar distribution across the categories (Figure 12). However, more studies specified research funders, with no agency type for over 900 studies (32%), and no name for over 700 (26%).

**Figure 12: Programme funder and research funder categories for impact evaluations**

Source: 3ie 2020. Descriptive analysis of data extracted from 1,838 included impact evaluations. Note: Where more than one funding agency was reported, multi-coding was permitted.

The top 10 programme funders, as defined by the count of unique programmes evaluated, are shown in Table 7. USAID, a government agency, was specified as funding programmes evaluated in 52 of the included studies, with the World Bank and the Bill & Melinda Gates Foundation funding the next-highest number of programmes evaluated by studies. Of the top 10 programme funders, 6 were government agencies, 2 were international aid agencies, 1 was a foundation and 1 was an international financial institution.
Table 7: Top 10 programme funders of impact evaluations

<table>
<thead>
<tr>
<th>Programme funding agencies</th>
<th>No.</th>
<th>Per cent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>USAID*</td>
<td>52</td>
<td>5.3</td>
</tr>
<tr>
<td>World Bank**</td>
<td>32</td>
<td>3.3</td>
</tr>
<tr>
<td>Bill &amp; Melinda Gates Foundation</td>
<td>31</td>
<td>3.2</td>
</tr>
<tr>
<td>DFID</td>
<td>27</td>
<td>2.7</td>
</tr>
<tr>
<td>UNICEF</td>
<td>24</td>
<td>2.4</td>
</tr>
<tr>
<td>World Food Programme</td>
<td>15</td>
<td>1.5</td>
</tr>
<tr>
<td>Government of India</td>
<td>14</td>
<td>1.4</td>
</tr>
<tr>
<td>National Institutes of Health***</td>
<td>12</td>
<td>1.2</td>
</tr>
<tr>
<td>Government of Mexico</td>
<td>12</td>
<td>1.2</td>
</tr>
<tr>
<td>Swiss Agency for Development and Cooperation</td>
<td>9</td>
<td>0.9</td>
</tr>
</tbody>
</table>

Source: 3ie 2020. Descriptive analysis of data extracted from 1,838 included studies.
Notes: *This includes sub-offices and projects of USAID. **This includes programmes, funds and committees associated with the World Bank. ***This includes the Fogarty International Centre and the Eunice Kennedy Shriver National Institute. The percentage provided does not include studies that did not specify programme funders.

The top 10 agencies that funded research were also identified (Table 8). Six agencies were in the top 10 for both programme and research funding, with USAID remaining the top funder. The agency categories also remained similar, with 5 government agencies, 1 international financial institution, 1 private foundation and 3 international aid agencies.

Table 8: Top 10 research funders

<table>
<thead>
<tr>
<th>Research funding agencies</th>
<th>No.</th>
<th>Per cent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>USAID*</td>
<td>103</td>
<td>5.0</td>
</tr>
<tr>
<td>Bill &amp; Melinda Gates Foundation</td>
<td>93</td>
<td>4.5</td>
</tr>
<tr>
<td>DFID</td>
<td>57</td>
<td>2.8</td>
</tr>
<tr>
<td>World Bank Group**</td>
<td>50</td>
<td>2.4</td>
</tr>
<tr>
<td>UNICEF</td>
<td>49</td>
<td>2.4</td>
</tr>
<tr>
<td>National Institutes of Health***</td>
<td>42</td>
<td>2.0</td>
</tr>
<tr>
<td>3ie</td>
<td>36</td>
<td>1.8</td>
</tr>
<tr>
<td>International Food Policy Research Institute</td>
<td>30</td>
<td>1.5</td>
</tr>
<tr>
<td>National Natural Science Foundation of China</td>
<td>28</td>
<td>1.4</td>
</tr>
<tr>
<td>National Council for Scientific and Technological Development</td>
<td>27</td>
<td>1.3</td>
</tr>
</tbody>
</table>

Source: 3ie 2020. Descriptive analysis of data extracted from 1,838 included studies.
Notes: *This includes sub-offices and projects of USAID. **This includes programmes, funds and committees associated with the World Bank Institute. ***This includes the Fogarty International Centre and the Eunice Kennedy Shriver National Institute. The percentage provided does not include studies that did not specify programme funders.

4.2.7 Impact evaluation and synthesis methods

Roughly three quarters of impact evaluations implemented randomised designs; a minority of studies used qualitative analysis to understand effect sizes or conducted a cost analysis.

Just over three quarters of included impact evaluations employed a randomised controlled trial design (n = 1,390) as their primary causal inference method, while the remaining quarter implemented quasi-experimental designs (n = 448). Of these latter studies, most used statistical matching (n = 242) and difference-in-differences (n = 136),
with fewer studies employing other designs, such as instrumental variable approaches (n = 41) and fixed effects estimation (n = 33).

Data were extracted with regard to whether impact evaluations also conducted complementary qualitative research to help explain effects. (Studies that reported using qualitative research to inform interventions and/or evaluation designs were not classified as qualitative research for this analysis.) In total, just over 10 per cent of impact evaluations adopted a mixed-methods approach (n = 186).

Finally, 173 impact evaluations (9%) reported cost data or presented a cost analysis in some form. Table 9 shows that of those that presented cost data, the majority presented detailed budget information or attempted to make some comparison between the costs of a programme and the additional benefits estimated. A comparison between costs and benefits include methods such as cost-effectiveness analysis, cost-benefit analysis and economic evaluation. Just under half (43%) of studies reporting cost data were published in or after 2018, which suggests that the inclusion of cost data in impact evaluations published in this sector is nascent.

Table 9: Overview of the type of costs and cost analysis presented in impact evaluations

<table>
<thead>
<tr>
<th>Cost presentation and analysis</th>
<th>No.</th>
<th>Per cent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>The programme budget is stated in some form (e.g. presented in total or per capita)</td>
<td>70</td>
<td>40</td>
</tr>
<tr>
<td>Programme costs are disaggregated in some way</td>
<td>28</td>
<td>17</td>
</tr>
<tr>
<td>Analysis of costs is undertaken</td>
<td>14</td>
<td>8</td>
</tr>
<tr>
<td>A comparison between costs and benefits is made using a cited method (e.g. cost-benefit analysis, cost-effectiveness analysis, economic evaluation)</td>
<td>61</td>
<td>35</td>
</tr>
</tbody>
</table>

Source: 3ie 2020. Descriptive analysis of data extracted from 174 included impact evaluations.

**Meta-analysis is the most common synthesis method, and a majority of systematic reviews sought to understand sources of heterogeneity.**

Review authors most commonly used meta-analysis to synthesise results across studies (n = 109; 62%), followed by descriptive or narrative analysis (n = 56; 32%) and vote counting (n = 9; 5%).12 (When there are enough similar studies to synthesise, meta-analysis has several advantages: transparency, estimating the heterogeneity in results and increasing statistical power.) Most reviews also explored how study impacts might vary by different moderating factors, often labelled an analysis of heterogeneity (n = 148; 76%). Where review authors examined possible sources of heterogeneity, meta-analysis by subgroup was the most common method (n = 64; 43%), followed by descriptive or textual analysis (n = 44; 30%) and meta-regression (n = 44; 18%).13

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12 This analysis was based on data extracted in 175 critical appraisals of systematic reviews included in this EGM. Information provided in three protocols was not appraised, and therefore not included in this analysis. Multi-coding of synthesis methods was permitted, which means the total count of methods used can be greater than 175.

13 In some cases, authors implemented multiple heterogeneity analyses. In these cases, multi-coding was permitted.
Low-confidence reviews did not clearly report screening and data extraction procedures, attempt to understand heterogeneity, or effectively assess and consider risk of bias present in studies.

Finally, each systematic review was critically appraised on the quality of methods employed to search for studies, assess the studies and synthesise the evidence.\(^\text{14}\) High confidence in the reported conclusions of a review occurs if the review conducted a comprehensive search, credibly assessed and reported risk of bias, reliability-screened studies and extracted data, and appropriately synthesised evidence. A low confidence rating occurs when the review used search, appraisal or synthesis methods likely to bias the results in some way.

Most studies were appraised as low confidence: 95 of completed reviews scored a 'low' confidence rating (54%); 46 (26%) were rated 'medium' confidence; and 34 (19%) were rated 'high' confidence.

Findings demonstrated that marginally more studies scored ‘low’ on synthesis methods (n = 95), than on search, identification and appraisal procedures used (n = 80), as shown in Figure 13. For synthesis methods, we found that unreliable reporting of study information was a key issue (n = 73), especially unclear reporting on whether study information was extracted by at least two reviewers. We also identified studies suffering from the following synthesis issues: unclear reporting on the risk of bias (n = 45), limited attempts to assess or understand possible sources of heterogeneity (n = 20), and inappropriate synthesis methods used relative to the question being answered (n = 19).

In the case of study identification and appraisal, all reviews specified at least some of the review scope criteria, but reviews had issues with respect to: possible bias in selecting which studies to include, typically not reporting that two reviewers independently screened studies (n = 53); the comprehensiveness of the search strategy (n = 46); and the criteria used to assess the study’s risk of bias or not assessing risk of bias at all (n = 41).

**Figure 13: Overview of systematic review critical appraisal results by key subdomains**

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\(^\text{14}\) The appraisal rubric we used is presented in full in Appendix D.
High-confidence reviews were mostly published in or after 2015 and are focused on synthesising available evidence on the effects of supplementation and fortification interventions.

High-confidence reviews appear to have been published in later years: just over 75 per cent (n = 26) of high-confidence reviews were published in or after 2015, compared to 60 per cent of low- and medium-quality reviews. The high-confidence reviews predominantly focused on synthesising the effects of the provision or use of supplements on birth outcomes (n = 10) and iron or anaemia status (n = 7) and the effect of fortification on iron or anaemia status (n = 8).15

5. Conclusions and implications

5.1 Answering our research questions

Based on the results presented above, answers to the research questions specified in Section 2 are presented below.

5.1.1 Research question 1 – Coverage

What are the extent and characteristics of existing empirical evidence regarding the effects of selected food systems interventions on food security and nutrition outcomes in L&MICs?

- **Evidence base**: 1,838 impact evaluations and 178 systematic reviews were identified. This evidence base has increased in size over a hundredfold in the last two decades.

- **Interventions**: Several intervention types were examined in over 100 impact evaluations and at least 20 systematic reviews. These interventions were mostly nutrition-specific and included supplementation, fortification, classes within the consumer behaviour domain, the provision of foods, peer support and/or counsellors, and agricultural extension programme components. Increasingly, interventions related to the food supply chain and consumer behaviour are being conducted. Three intervention areas with no identified impact evaluations were identified: advertising regulations, food waste education programmes and direct packaging of food. There were also several interventions that had been examined by impact evaluations but had few to no identified systematic reviews, such as agricultural extension and agricultural information provision.

- **Outcomes**: There was broad coverage of most final outcomes, but less evidence on the effects of food systems interventions on food safety, affordability and availability outcomes. Fewer studies examined intermediate outcomes until recently. In particular, there was less evidence on outcomes relating to economic, social and political stability; regulations; food loss; the environmental impacts of the food system; food distribution; measures of diet insufficiency; advertising; and labelling. That said, study authors are increasingly examining intermediate, or both intermediate and final, outcomes in their studies.

- **Geography**: The most common study location was Sub-Saharan Africa, lower middle-income countries and countries without fragility issues. India, China and Bangladesh hosted the most impact evaluations, accounting for nearly one fifth of all studies, collectively. Among fragile states, Mali, Mozambique and the Democratic

15 Multi-coding was permitted in this analysis.
Republic of Congo were the most common study locations, and there were no major differences in interventions used in fragile states and non-fragile states.

- **Populations and settings:** Impact evaluations mostly targeted both sexes and people of diverse ages, except those over 60 years of age. Most impact evaluations were conducted at a local level in households, and over half were in rural areas.

- **Methods:** Roughly three quarters of impact evaluations implemented randomised designs, and a minority of studies sought to understand effect sizes using qualitative analysis or conducted a cost analysis. High-confidence systematic reviews were mostly published in or after 2015, and are commonly focused on synthesising the effects of supplementation and fortification interventions.

5.1.2 Research question 2 – Gaps

**What are the major primary and synthesis evidence gaps in the literature?**

Table 10 shows, at a high level, areas where there is impact evaluation evidence available to inform development policy. The numbers in each cell indicate the number of studies that assessed the causal link between the related intervention-outcome combination. As an example, the map indicates that a high volume of impact evaluation evidence on the effects of affordability and availability interventions and micronutrient status outcomes is available (n = 286).

In contrast, few studies evaluated the effect of food loss and waste management or promotion and labelling interventions on any of the outcomes of interest, and fewer studies considered the effects of interventions on food safety outcomes. To illustrate how this map can be used in more detail, a range of EGM use case examples are discussed in Appendix G, which draw on the results of the EGM, authors’ own experiences and the considerations set out in Section 1.2.

Table 10: High-level summary of the evidence mapping of impact evaluations

<table>
<thead>
<tr>
<th>Intervention / outcome</th>
<th>Food safety</th>
<th>Food affordability &amp; availability</th>
<th>Micro-nutrient status</th>
<th>Diet quality &amp; adequacy</th>
<th>Developmental outcomes</th>
<th>Anthropometric</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production system</td>
<td>4</td>
<td>54</td>
<td>20</td>
<td>84</td>
<td>3</td>
<td>44</td>
</tr>
<tr>
<td>Distribution &amp; storage</td>
<td>1</td>
<td>8</td>
<td>1</td>
<td>8</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Processing &amp; packaging</td>
<td>7</td>
<td>6</td>
<td>215</td>
<td>48</td>
<td>50</td>
<td>146</td>
</tr>
<tr>
<td>Food loss &amp; waste management</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Affordability</td>
<td>1</td>
<td>15</td>
<td>5</td>
<td>46</td>
<td>4</td>
<td>34</td>
</tr>
<tr>
<td>Availability</td>
<td>18</td>
<td>26</td>
<td>282</td>
<td>119</td>
<td>64</td>
<td>288</td>
</tr>
<tr>
<td>Promotion &amp; labelling</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Women’s empowerment</td>
<td>0</td>
<td>3</td>
<td>3</td>
<td>6</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Information / BCC</td>
<td>10</td>
<td>11</td>
<td>57</td>
<td>300</td>
<td>36</td>
<td>234</td>
</tr>
<tr>
<td>Multicomponent</td>
<td>0</td>
<td>9</td>
<td>16</td>
<td>43</td>
<td>8</td>
<td>48</td>
</tr>
</tbody>
</table>

Source: 3ie 2020. Descriptive analysis of data extracted from 1,838 included impact evaluations.

Notes: BCC = behaviour change communication. If a study evaluated multiple interventions and outcomes, the study was counted multiple times. This means that the total number of studies reported here is higher than the actual number of studies included in the map.

16 The fully disaggregated interactive evidence gap map associated with this project can be found here: https://gapmaps.3ieimpact.org/evidence-maps/food-systems-and-nutrition-evidence-gap-map
Given the volume of studies included, it is not feasible to discuss all potential gaps identified by the exercise in this report. Instead, focus was directed towards several gaps of interest outlined in more detail below:

**Women’s empowerment:** Women are traditionally significant actors within food systems. However, relatively few studies were identified that examined interventions supporting women’s decision-making or measured outcomes regarding women’s empowerment. Some interventions did specifically target women, but typically as mothers whose health affects the health of their infants. Many more studies focusing on women fell within the consumer behaviour domain, targeting women as cooks and breastfeeding mothers, rather than as actors within the food supply value chain.

**Under-researched but commonly implemented interventions:** Several interventions were identified that are not well researched but have been widely implemented. For example, taxes on sugar-sweetened beverages and labelling regulations for unhealthy foods have not been evaluated for their impacts on weight, yet more than 40 countries (many of them L&MICs) tax sugar-sweetened beverages, and several (including Brazil, China and Thailand) have adopted labelling regulations (OEH 2020; Zhang et al. 2014) in an effort to fight the obesity epidemic. Similarly, funders commonly support post-harvest processing interventions to impact a range of outcomes. However, impacts were only found in four evaluations that examine these interventions.

**Intervention scale:** The vast majority of evaluations took place at the local and subnational level, resulting in less evidence on national and transnational interventions. Local programmes, while important, do not require the resources of national and transnational programmes, nor do they affect as many people. As both resources and reach increase, the ethical imperative for evaluations also increases because the potential harm is larger. Although evaluations of these large-scale interventions can be difficult because randomisation is not practical, quasi-experimental designs can be employed.

**Magnitude of diet quality and adequacy outcomes:** The 400 studies that used ‘other dietary quality and adequacy’ outcomes represent an interesting gap for evidence synthesis. These studies did not measure micronutrient status, dietary diversity, breastfeeding or sufficiency as related to an established standard, but used other approaches to quantify diet. Often, these approaches involved reporting the intakes of specific foods or food groups. While providing a wealth of information, the variation in outcomes makes drawing conclusions across studies challenging, thereby potentially requiring the use of novel synthesis methods.

**Method considerations:** There are several important methodological gaps. The strong focus on randomised trials provides rigorous evidence but can also result in interventions that do not lend themselves to randomisation being understudied. Mixed-methods approaches and those considering cost evidence are also severely underrepresented in the literature. As a result, there is little evidence regarding why these interventions work or if they were worth the investment.
5.1.3 Research question 3 – Research needs
What intervention and/or outcome areas could be prioritised for primary research and/or evidence synthesis?
Below is a partial list of interventions and outcomes that are identified as understudied by this mapping exercise and may be of interest to stakeholders when considering the allocation of research and programming resources.

**Illustrative list of interventions to prioritise for evaluation**
- Government manipulations of price
- Advertising and labelling regulations
- On-farm, post-harvest processing
- Interventions to support food packaging
- Efforts to support women’s empowerment within the food system
- Innovative store design
- Cold chain storage

**Illustrative list of outcomes to prioritise for evaluation**
- Women’s empowerment
- Economic, social and political stability
- Food loss
- Environmental impacts of the food system
- Measures of diet insufficiency

**Illustrative list of evidence synthesis priorities**
- Agricultural extension and information-sharing activities within the food value chain
- Provision of free or reduced-cost farm inputs to crop production
- Educational approaches within the food value chain
- Agricultural insurance products
- Outcomes related to other diet quality and adequacy measures

5.2 Implications for policy and research
Based on the results presented in this review and discussion with the project advisory group, the following subsections propose a set of implications for policy and practice and research in the sector.

5.2.1 Policy and practice
- **Make use of high-quality systematic reviews:** A total of 34 high-quality systematic reviews were identified. If one or more of these reviews relates to an area relevant to you as a reader, the authors of this study think there is value in consulting them – particularly for the design and development of new policies and programmes.
- **Consider investing in under-researched areas:** The map identified several intervention-outcome combinations where there is relatively little impact evaluation evidence, and others where the intervention mechanism is not well understood. If these areas align with any of your existing or planned programming priorities, consider allocating resources to fund theory-based, mixed-methods impact evaluations.
• **Contextualise the evidence mapping with other sources:** When using this map to make strategic and/or resource allocation decisions, triangulate the results of our mapping with other information sources to assess how meaningful the identified gaps are for your context. Other sources that can be used to support decision-making include:
  o Existing or planned research and interventions by government agencies and development partners;
  o Other forms of evidence, including implementation research, process evaluations, qualitative studies, and programming administrative and monitoring information;
  o Existing theories of change and logical frameworks; and
  o Your own formative work and local knowledge.

• **Be cautious when considering implementing under-researched interventions:** Several widely implemented interventions, such as those related to labelling and advertising regulations, were found to have relatively weak evidence bases. The implementation of these interventions without additional research could lead to unintended consequences and/or the inefficient use of limited resources.

5.2.2 **Research**

• **Consider more nuanced analysis in well-researched areas:** The mapping identified several well-evidenced areas, such as studies looking at the effects of fortification and supplementation interventions. In the future, research could assess effects for different populations and examine the intermediate steps in a theory of change, either quantitatively, as part of an impact evaluation or quantitatively as part of an impact evaluation or systematic review.

• **Consider standardising outcome measures relating to diet quality and adequacy:** A range of outcome measures that assessed diet quality and adequacy were identified. While these measures may reflect local contexts, there is an opportunity to standardise the measures used in future to aid the synthesis and use of evidence.

• **Support cost and mixed-methods evidence:** There were very few impact evaluations that reported on cost evidence or used qualitative analysis to understand quantitative results. However, this evidence is necessary to understand how limited resources can be best allocated and the mechanisms through which changes may occur, respectively. Qualitative information can also help to inform whether impacts might vary by population or setting.

• **Research should seek to address food systems complexity:** Interventions within the food system are often interlinked with other activities at different points, or interventions outside the food system, such as clinical interventions. Any future primary research or synthesis should consider how the different links and drivers of the food system might affect results, and how this might vary across different contexts. A good starting point would be to consider how the different drivers defined in HLPE 2017 that affect the food system might impact an intervention or population of interest.

• **Assessment of effects where randomisation is not possible:** The current evidence base mainly comprises randomised controlled trials. While randomising units is the cleanest way to address selection bias, focusing on this approach can limit which interventions are studied because randomisation is not always feasible (e.g. for the implementation of tax schemes). If a meaningful evidence gap is identified and randomisation is not possible, creative quasi-experimental designs might provide important evidence without sacrificing much rigor.
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Appendixes

Online appendix A: Additional methods detail

Online appendix B: Example search string
https://www.3ieimpact.org/sites/default/files/2021-01/EGM16-Online-appendix-B-Search-strategy.pdf

Online appendix C: Data extraction codebook
https://www.3ieimpact.org/sites/default/files/2021-01/EGM16-Online-appendix-C-Data-extraction-codebook.pdf

Online appendix D: Summary of the systematic review critical appraisal tool

Online appendix E: Table summaries of results
https://www.3ieimpact.org/sites/default/files/2021-01/EGM16-Online-appendix-E-Table-summaries-of-results.pdf

Online appendix F: Additional analysis - Global Nutrition Report 2020 comparison

Online appendix G: Examples for using this EGM to inform practice or research
https://www.3ieimpact.org/sites/default/files/2021-01/EGM16-Online-appendix-G-Examples-for-using-this-EGM-to-inform-practice-or-research.pdf
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