

Food safety and the Sustainable Development Goals

Delia Grace

Introduction

The objective of this brief is to set out linkages between food safety and the Sustainable Development Goals (SDGs), to identify priority issues, and to suggest how investments in food safety can help attain SDGs. The focus is on low- and middle-income countries (LMIC) whose development needs are most urgent and where the burden of foodborne disease (FBD) is highest. We discuss both the likely role of food safety in contributing to or retarding progress to meet SDGs as well as the interventions or responses that can maximise benefits and reduce risks. We draw attention to unintended consequences of food safety interventions, which, while attempting to improve public health, may jeopardise other objectives such as improving nutrition or gender equity.

Sustainable Development Goals

In 2015, the United Nations General Assembly adopted the new development agenda: *Transforming our world: the 2030 agenda for sustainable development*. Following on from the Millennium Development Goals (MDGs), this comprised a set of 17 goals to end poverty, protect the planet, and ensure prosperity for all. These goals integrate all three dimensions of sustainable development (economic, social and environmental) and have specific targets (169) to be achieved by 2030. Three of these goals are primarily health related: SDG 3 'Good health and wellbeing' focuses on health, while SDG 2 'Zero Hunger' encompasses eradication of nutrition and nutrition associated disease and SDG 6 'Clean water and sanitation' is a pre-requisite for health.

Food safety

FBD are illnesses caused by contaminated, or naturally harmful, food or drink. FBD is the result of ingestion of food safety hazards. A food safety hazard is anything in food that can harm consumers' health. Hazards are often classified as biological (for example bacteria or parasites), chemical (for example heavy metals or pesticides) and physical (for example fragments of metal or glass).

Many FBD are zoonotic (that is, diseases transmissible between animals and people). Some are also new and emerging diseases (that is, novel diseases or diseases changing in their hosts, geography or impacts (such as bovine spongiform encephalopathy or new variants of highly pathogenic avian influenza). Emerging diseases have the potential to cause pandemics, or widespread diseases affecting large numbers of people. Other issues associated with food consumption and production and closely linked to food safety, include non-communicable diseases associated with overweight and obesity, antimicrobial drug resistance, food allergies and intolerances, food adulteration, food fraud, bioterrorism and food waste.

Food safety is an essential part of food security. However, FBD has not been a development priority and food security policies and initiatives have often given scant attention FBD. This neglect can partly be attributed to lack of evidence on the burdens of FBD (health and other) and the costs and benefits of tackling FBD. Indeed, systematic and comprehensive evidence on the health burden of FBD in developing countries started to become available only recently. The landmark first assessment of the global burden of FBD, conducted by the World Health Organization (WHO) considering 31 hazards for which there was enough information to allow global burden estimates, was published in 2015 (Havelaar et al. 2015).

FBD has a health burden comparable to malaria, HIV/AIDS or tuberculosis (Havelaar et al. 2015).
--

The 31 foodborne hazards considered in this WHO report caused an estimated 600 million foodborne illnesses and 420,000 deaths in 2010. The global burden was 33 million Disability Adjusted Life Years

(DALYs) (one DALY corresponds to one lost year of healthy life); children under five years old bore 40% of this burden, although they comprised only 9% of the global population. The 14 subregions, defined on the basis of child and adult mortality, had considerably different burdens of FBD, with the greatest per capita burden in subregions in Africa, followed by the subregions in South-East Asia and the Eastern Mediterranean D subregion. Most (98%) falls on developing countries and most (97%) was due to biological hazards: bacteria, viruses and parasites.

FBD has other direct and indirect development implications. Directly, it imposes a huge economic burden across the health, agri-food and other sectors. It is also a barrier to trade and to access to high value markets. It is an area of immense and growing concern to consumers. This concern makes FBD a policy priority and the last decades have seen radical re-structuring of food safety in countries, following high profile food scares (for example, bovine spongiform encephalopathy in beef in the United Kingdom and melamine in dairy products in China) or continued concern over food safety (for example, recent comprehensive food safety legislation in India and the United States of America). Because concern over FBD is a potent influencer of the development and trajectory of the agri-food system, FBD indirectly affects a wide range of social, economic and environmental processes including: consumption behaviour; food production and hence environmental impacts of agriculture; participation of women and the poor in value chains; food trade; and, water and energy use. This implies that, as for health, food safety and FBD are relevant to a wide range of SDGs.

In Vietnam, a nationally representative study found that food safety was the issue of highest concern to citizens, more important than governance, health care or education (USAID 2015).

Food safety is not salient in SDGs but may become more important

The SDGs cover a much broader set of topics than the MDGs. Notably the health goal explicitly covers reproductive, maternal, newborn and child health, infectious diseases, non-communicable diseases, mental health, road traffic injuries, environmental health consequences and health systems strengthening. However, both the SDG and the related WHO Health Statistics make little mention of FBD: this is in contrast to malaria, HIV/AIDS, tuberculosis and water associated disease which are covered in great depth in the papers and targets (<https://sustainabledevelopment.un.org/sdg3>) (WHO 2016; WHO 2017).

The lack of salience in FBD could be because the thinking and planning of SDGs reflects several years of work, much of which happened before the publication of the first global assessment of the burden of FBD. However, it also reflects a general low awareness of the importance of food safety among public health professionals and development actors. Moreover, because FBD is an inter-sectoral problem, occurring at the interface of health, agriculture, and industry, it may be systematically under-estimated.

Given ongoing learning from implementation of SDGs, it is likely there will be a refocusing, with more emphasis given to goals for which there is strong evidence investments will lead to major benefits and represent best value for money. One expert assessment identified 19 targets that represented best value for money, offering more than \$15 for every dollar invested (Copenhagen Consensus 2017): nine of these were health-focused (e.g. reduce tuberculosis deaths by 90%). FBD was not included, but the type of costs and benefits which led to health investments being so attractive are likely to apply also to FBD.

Moreover, the very success in reaching health goals creates more need for addressing food safety. For example, dramatic progress in providing safe water means that more of the burden of gastro-intestinal disease comes from food. (In 2015, 91% of the global population used an improved drinking water source; 2.6 billion people have gained access to improved water since 1990 [WHO/UNICEF 2015]). Similarly, the striking declines in malaria and tuberculosis means that FBD makes up relatively more of the infectious disease burden. It is likely therefore that FBD will become increasingly important in LMIC, as has been the

case in high-income countries where other infectious diseases have seen consistent and substantial declines whereas progress in reducing FBD has been less marked.

A One Health approach to SDGs: understanding interactions between goals

Building on the success of the MDGs, the SDGs set an unprecedentedly ambitious, broad, integrated, and inclusive set of goals for improving the well-being of people and the planet. Stakeholders have overwhelmingly mobilized around the SDGs and any initiative for improving food safety, especially in LMIC must be situated within their context. However, SDGs have been criticized for not reflecting effective prioritization, for spreading aid too thinly, for setting goals which are not realizable, for being extremely expensive to monitor and for lacking coherence. At the same time, some evaluations find that progress is meager (GlobeScan 2017) and some goals are unattainable on present trajectories.

A widely acknowledged strength of the SDGs is their emphasis on people, prosperity and the planet or social, economic, and environmental pillars of sustainability (HLPE 2016). However, the reach of goals means that interactions between groups of goals are inevitable. Generally, interactions at the inner level (people) provide opportunities for synergies and win-wins. However, some infrastructure goals (economic growth, industrialization and consumption/production) can have an antagonistic relation with environmental goals, which in turn can have adverse on people goals (Figure 1) (Queenan et al. 2017). It is argued that because different sectors developed SDGs without enough emphasis on interactions, sustainable development may be undermined by negative trade-offs between different goals (Waage et al. 2015).



Source: Queenan et al. (2017)

Figure 1: A framework grouping SDGs by domain and highlighting in yellow goals with antagonistic outcomes.

While food safety has obvious direct links to SDGs, especially those focused on wellbeing, it can also interact with other goals in complex ways. These we call un-intended consequences, as these are often not considered in the pursuit of attaining another desired goal. These unintended consequences have been

neglected in the literature but there is some evidence that they their consequence is high, in some cases higher than direct effects of FBD (Grace 2016).

Concerns over public health motivate efforts to control zoonotic pandemics such as highly pathogenic avian influenza. Control efforts in LMIC often involved mass killing of poultry and restrictions on how poultry were kept. A study in Egypt found that control impacts resulted in a significant decrease in consumption of poultry and eggs and this in turn led to increased stunting: the health burden of which was likely greater than the health burden directly attributable to avian influenza in people (Kavle et al. 2015).

The contribution of food safety in attaining specific SDGs

The next section looks at food safety and FBD in relation to specific SDGs. We first identify how safe food can directly contribute to attainment of the goal (causal links); next we consider how food safety might correlate or be linked to other factors that are needed for the goal or how the attaining the goal might contribute to improved food safety (bi-directional relations); finally, we examine how concerns over food safety could have implications for attaining the goal (unintended consequences).

Food safety is integral to attaining the goal

SDG 3: Good health and well-being	Causal	<ul style="list-style-type: none"> • FBD are an important contributor to health burdens in LMIC: the burden is comparable to malaria, HIV/AIDS and tuberculosis. • FBD are associated with correspondingly large costs and psychosocial distress, which can also negatively impact good health and wellbeing. • FBD are more common and frequent in LMIC than in high-income countries and may be trending upwards in LMIC in response to increase in demand for more risky foods along with poorly governed agri-food system transformation. • Production, processing and consumption of food is also associated with diseases, and the associated health, psychological and economic burdens. These include exposure of agri-food sector workers to occupational hazards (e.g. pesticides or pathogens) as well as diseases associated with agriculture (e.g. antimicrobial resistant pathogens resulting from use of antimicrobials in food animals and pandemics emerging from intensively kept, genetically similar livestock).
	Bi-directional	<ul style="list-style-type: none"> • FBD is related to other diseases which threaten good health: <ul style="list-style-type: none"> ○ FBD is a risk factor for stunting and malnutrition and vice versa: stunted children are more vulnerable to FBD and FBD increases the chance of being malnourished. ○ People with compromised immunity, infants, the elderly and pregnant women are especially vulnerable to FBD. ○ FBD may result in lowered effectiveness of vaccines. • The foods with most potential to address under-nutrition (animal source foods and fresh vegetables) are also the riskiest in terms of being sources of FBD.
	Unintended	<ul style="list-style-type: none"> • Concerns about food safety may shift diets in directions that affect health: <ul style="list-style-type: none"> ○ Concerns over FBD are often a factor in driving increased consumption of local, organic or certified food which may have social, health (reduction in non-communicable disease) and environmental benefits but which may also lead to reductions in total amount of food produced and so have negative nutrition impacts. ○ Concerns may also lead to increased consumption of processed and packaged food which may have negative nutrition impacts (increased non-communicable disease associated with overweight/obesity and increased malnutrition associated with decreased consumption of nutrient rich, minimally processed, fresh foods).

Food safety has a significant influence on attaining goals

SDG 6: Clean water and sanitation	Causal	<ul style="list-style-type: none"> • Many infectious FBD can be transmitted via water and people and animals infected with these diseases can contaminate water making it less safe (e.g. cysticercosis, cryptosporidiosis).
	Bi-directional	<ul style="list-style-type: none"> • Lack of clean water for washing food and food equipment and for food handler hygiene increases the risk of food being unsafe. • Food production and processing may use a large amount of water reducing the availability of water for other uses such as sanitation and drinking. • Water sources provide a habitat for many food and waterborne pathogens and vectors such as schistosomes and the aquatic hosts of human infective fluke • Food production and processing can contaminate and pollute water sources leading to lack of clean water and if this water is used in food processing it can contaminate food. Intensive production of animal source food (livestock and fish) is especially likely to contaminate water sources. • Wastewater (grey water) is often high in nutrients and methods exist to allow safe recycling and use for agricultural production. • Agriculture can also protect water quality if well managed, for example, agro-forestry along river banks can prevent erosion and reduce contamination or stocking sheep next to watercourses instead of cattle.
SDG 1: No poverty	Causal	<ul style="list-style-type: none"> • Ill health is a major factor in causing and maintaining poverty. FBD is one of the major causes of ill health in LMIC. • FBD is associated with a range of costs that fall on poor people and contribute to their remaining in poverty: <ul style="list-style-type: none"> ◦ Cost of illness including out of pocket expenses and lost days of work. ◦ Some FBD can result in catastrophic illness (e.g. paralysis, brain damage) which can result in permanent descent into poverty. ◦ Food which is visibly contaminated or unsafe is often sold at a lower price or cannot be sold at all resulting in financial loss to producers and value chain intermediaries. ◦ FBD, which are zoonotic often, result in losses in livestock or reduced value of livestock products. Other agents may cause both FBD and reduction in crop productivity (e.g. the moulds which produce aflatoxins). • Beyond the direct costs of illness, disease may also act as a 'poverty trap' that is, a self-reinforcing mechanism causing poor individuals or countries to remain poor (Grace et al. 2017).
	Bi-directional	<ul style="list-style-type: none"> • Poverty is a major risk factor for FBD nationally, at household and at individual level. <ul style="list-style-type: none"> ◦ The WHO report suggests that 98% of the burden of FBD falls on developing countries ◦ Many FBD are zoonotic and the burden of zoonotic diseases is also much higher in developing countries • At the same time, while most infectious diseases show a rapid decline with improving wealth, this is less marked in the case of FBD.
	Unintended	<ul style="list-style-type: none"> • Concerns over FBD lead to standards and enforcement in some markets (especially export and high value domestic), which can result in high costs of compliance or exclude the poor from participation reducing opportunities for income generation. • Concerns over FBD can lead to government or donors discouraging certain food sectors or actors (smallholders, street vendors), which can reduce their income through market exclusion or through the necessity of paying bribes.
SDG 2: Zero hunger (sustainable	Causal	<ul style="list-style-type: none"> • Food security entails food safety and hence food security cannot be attained if food is not safe • Unsafe food may be destroyed resulting in reduced food availability

agriculture)	Bi-directional	<ul style="list-style-type: none"> • FBD has multiple complex interactions with nutrition. These include: <ul style="list-style-type: none"> ○ Causing illness, which worsens nutritional status. ○ Toxins may directly lead to malnutrition, for example, there is a strong association between ingestion of aflatoxins and stunting. ○ Food production (livestock) may result in greater exposure to animal faecal bacteria which is associated with environmental enteric dysfunction. ○ FBD is especially problematic when infants are first introduced to foods. • The most nutritious foods are also the most implicated in FBD (animal source food and fresh vegetables).
	Unintended	<ul style="list-style-type: none"> • Attempts to improve food safety by making illegal or discouraging foods or food sectors perceived as risky (e.g. street food or raw milk) often increase the price and decrease the proximity of food to poor people which can have adverse nutritional consequences. • Concerns over food safety can also affect food security: <ul style="list-style-type: none"> ○ Consumer concerns of over FBD can reduce food availability. ○ Concerns over FBD can change consumption patterns resulting in reduced consumption of fresh foods. ○ Control of FBD can reduce availability.

Food safety contributes to attaining goals

SDG 9: Industry, innovation and infrastructure	<ul style="list-style-type: none"> • In most LMIC, agri-food chains are undergoing rapid growth and transformation in response to growing demand of food and change in dietary habits. This change is most pronounced for animal source foods, fresh fruits and vegetables and processed foods, and higher concern over food safety is a feature of these changes. This demand-driven change drives innovation in food technology and marketing. • Infrastructure is an important factor in food safety. Improvements in transport can reduce FBD associated with keeping food for longer times at high temperatures (microbial pathogens). • Improved infrastructure tends to increase market orientation of farmers and use of agricultural inputs: this can increase risk from chemical hazards. When value chains lengthen and become more complex, there may be greater risk of FBD. • There are risks that concerns over FBD could exclude small-scale actors from emerging opportunities in food production, processing and retail.
SDG 12: Responsible consumption	<ul style="list-style-type: none"> • Reducing the high level of waste and losses and rebalancing the share of animal products in diets can contribute to sustainability and health. • There are complex interactions between dietary composition, dietary sustainability and risks of FBD. In general, increasing consumption of fresh, locally produced vegetables would reduce non-communicable disease and lower environmental costs but it would lead to increased waste and increased FBD unless mitigation is in place. Meanwhile, decreasing animal source food consumption would bring likely health benefits for developed countries but worsen nutritional status in many developing countries. Animal source food is associated with a higher environmental footprint.

SDG 8: Decent work and economic growth	<ul style="list-style-type: none"> • FBD entails high costs, which have negative impacts on economic growth. There is good evidence that investment in control of FBD can have economic benefits. For example, a review found that there was \$6 benefit for every \$1 invested in brucellosis control; the average benefits per dollar were higher in developing countries (McDermott et al. 2013) • Especially, in developed countries a significant proportion of costs are incurred by the agri-food industry, slowing economic growth • FBD also results in lost value from exports that are rejected and lost opportunities when countries cannot meet standards. • FBD are often transmitted by multiple routes and many are occupational risks for those working in the agriculture and food sector. • While imported food is often safer than domestically produced food in LMIC, there is a risk of 'dumping' unsafe food on less discriminating markets. • There are also cases where detection of hazards in exports alerted authorities and researchers to previously unknown hazards present in domestic markets. For example, high levels of toxic chemicals were discovered in smoked fish exported from Côte d'Ivoire to France leading to improvements in local production (Roesel and Grace 2014). • In Africa and Asia, most production and distribution of food occurs in the informal sector. This provides employment to billions of people. Agri-food sectors are responding to increased and changing demand by restructuring; this development could provide new opportunities to smallholders and small-scale market actors. However, food safety is an important mediator of the trajectory of restructuring and if smallholders and small-scale actors (many of the women) cannot meet food safety requirements they risk will be forced to exit markets.
SDG 5: Gender equality	<ul style="list-style-type: none"> • Women have a major role in agricultural production. In many countries, they predominate in livestock and horticulture and often have a role in crop production. • Most fresh foods in LMIC are processed, sold and cooked by women. As food production and distribution systems develop, women often fall out of these systems removing an important source of their income and power. • Food is a gendered commodity and there are many taboos around food consumption that overall tend to nutritionally disadvantage women • Men and women have different vulnerabilities to FBD and pregnant women are especially vulnerable
SDG 10: Reduced inequalities	<ul style="list-style-type: none"> • FBD are most common and serious in vulnerable populations specifically the young, the old, the pregnant, the malnourished and the immunosuppressed. Hence FBD can contribute to worsening inequities. • Some FBD result in social stigmata and hence social disapproval, for example, in many poor, pig-keeping communities cysticercosis is a major cause of epilepsy, and epilepsy is often stigmatised • Livestock, horticulture and crops are a source of income, create employment and small enterprise opportunities and provide market participation to poor rural households. Concerns over food safety may exclude these from increasingly demanding markets.
SDG 14: Life below water	<ul style="list-style-type: none"> • Fish is a major source of dietary protein but also highly vulnerable to contamination resulting in disease and food losses. • Demand for fish is increasing rapidly in LMIC, which is putting increasing pressure on wild sources as well as stimulating rapid growth in aquaculture. • Some livestock systems use large amounts of fishmeal as feed, and the sector's water pollution can lead to eutrophication and hypoxic water conditions.
SDG 15: Life on land	<ul style="list-style-type: none"> • Livestock products are highly nutritious but have a disproportionately high contribution to FBD. • Demand for livestock products is increasing rapidly in LMIC resulting in significant restructuring of livestock systems. • Livestock use major swathes of land and can have both positive and negative effects on biodiversity depending on how they are managed. • Bushmeat is an important source of animal source foods in some communities. Methods of capture and sale mean that risk of FBD is high as well as the risk of occupational health hazards to hunters. Over-use of bushmeat can also reduce biodiversity and ecosystem resilience.

SDG 11: Sustainable cities and communities	<ul style="list-style-type: none"> • Concerns over food safety put urban agriculture and wet markets at risk. <ul style="list-style-type: none"> ◦ Hundreds of millions of people in cities are engaged in urban agriculture which produces much of the fresh foods consumed within cities and contributes to food security, nutrition, jobs creation and liveability but which require management of health and sanitation threats. ◦ Vibrant traditional wet markets and street foods are an important contributor to culture, tourism, and livable cities.
---	---

Food safety is a minor consideration in attaining goals

SDG 16: Peace, justice and strong institutions	<ul style="list-style-type: none"> • Much food is produced by smallholders and in many systems land tenure is a constraint. • Much food is sold in informal sector, which had been often ignored by development initiatives and is vulnerable to official 'crack-downs' and other actions.
SDG 4: Quality education	<ul style="list-style-type: none"> • Animal-source foods are key to cognitive development in children, and there is some evidence that concerns over FBD decrease their use in school meals and other programs.
SDG 7: Affordable and clean energy	<ul style="list-style-type: none"> • Food preparation and cooking is an essential part of reducing risk of FBD but also a major user of fuel.
SDG 13: Climate action	<ul style="list-style-type: none"> • Many FBD are climate-sensitive and will change (often increasing) in response to climate change • Agriculture (especially livestock production) contributes significantly to greenhouse gas emissions, but there is also have large mitigation potential • Meeting needs for safe and nutritious food will entail adaptation to climate change

Promising investments for improving food safety

Much previous development interest focused on regional and international food trade as a pathway out of poverty and means to improving food security. In this context, addressing food safety is a way of increasing the benefits and reducing the risks of trade. Various recommendations have been made on international trade for health and poverty alleviation goals (Hawkes et al. 2015; Humphrey 2017).

Without doubt, the greatest burden associated with FBD and the greatest possible interactions with SDGs is due to FBD resulting from food sold in the mass markets of developing countries. There is limited literature on domestic food safety regulation in developing countries shows that we do not yet have good models for standards and approaches that can work at scale to assure food safety where risks are pervasive, costs of compliance are high and enforcement capacity is weak (Grace and Unnevehr 2013). Given the very different farming systems and regulatory environments, the approaches used successfully in Europe cannot be directly applied to developing countries. Several food safety interventions have been tried and evaluated with little evidence for benefit or sustainability. Nonetheless, other initiatives show promise, and a smaller number have been able to demonstrate sustained and scalable benefits.

- There is a consensus that food safety is best managed by a 'farm to fork' or 'boat to throat' approach that tackles food safety along the value chain. There should also be multiple barriers (or redundancy) in the system so that if one barrier to contamination fails there are other opportunities to block contamination or decontaminate. Food safety risks are best assessed, managed and communicated using Risk Analysis principles and methods which have been well described by Food and Agriculture Organization of the United Nations (FAO), WHO, Codex Alimentarius Commission and others and are the basis of international trade under the auspices of the World Trade Organization.
- Promising interventions at farm level include: organising producers in co-operatives or self-help groups thus making food safety capacity building easier; community-based or group certification to meet food safety standards; out-grower or contract schemes that include farmer training and support; farmer field schools and training in good agricultural practices and integrated pest management; technologies to reduce risk on farm such as vaccines for pig tapeworms. These interventions can also

improve smallholder incomes, introduce other practices for better business and environmental protection, and improve the safety of food produced and consumed by farmers.

- Promising interventions along the value chain include: providing and upgrading infrastructure such as roads and electricity; technical innovations such as cooling devices and water disinfection; vertical integration so that firms can manage safety; traceability; good manufacturing processes and approaches such as Hazard Analysis and Critical Control Point. Promising interventions at retail include: modernising retail; development of high-end niche domestic value chains; Training informal sector retailers and street sellers; training food handlers. These interventions can also have economic, equity and environmental benefits. Promising interventions at consumer level include: education and information and leveraging consumer willingness to pay for food safety to support development of safer food chains.
- Improvements in food safety governance are key to safer foods in domestic markets: an up-to-date and rational food safety system underpins delivery of food safety, but regulatory enforcement must not be over-relied on. The concept of co-regulation emphasizes coordination between public and private agents in the regulatory process (Eijlander 2005). A single unified food safety authority or a well-integrated system is likely to be more effective than the fragmented food safety system that often exists but is not enough to improve food safety. When restructuring is not possible because of historical or political reasons, a national food control strategy can identify roles of the different government divisions involved in food safety

Conclusion: Towards a One Health vision of SDGs

The SDGs offer an opportunity to address the major challenges facing humanity in ways that will not make things worse in trying to make things better. Food safety is moving rapidly up the global agenda as information emerges on the high and multiple burdens of FBD and the many interactions with other societal goals such as gender equity, nutrition and clean water. Moreover, FBD occurs at the intersection of health and agriculture and it is likely that the current fragmented framework of health governance, and disconnections between agriculture, health and ecosystems results in systematic under-estimation of the problem of FBD and undermines its management. Greater collaboration among food, water and the health and nutrition sectors, in the design and financing of programs to address food safety can contribute to helping meet multiple SDGs while acting as a model for managing complex, intersectoral problems. One Health, a broad movement that recognizes that human, animal and ecosystem health are interdependent and that multidisciplinary collaborations are often necessary to attain optimum health solutions, offers an appropriate framework for better tackling food safety in developing countries.

Further reading

The arguments and evidence on which the brief is based are drawn mainly from recent reviews of food safety in developing countries by ILRI and partners.

- Grace, D. 2015. *Food safety in developing countries: An overview*. London, UK: Evidence on Demand. http://dx.doi.org/10.12774/eod_er.oct2015.graced
- Grace, D. 2015. Food safety in low and middle income countries. *International Journal of Environmental Research and Public Health* 12(9): 10490–10507. <http://dx.doi.org/10.3390/ijerph120910490>
- Grace, D. 2016. Influencing food environments for healthy diets through food safety. In: FAO, *Influencing food environments for healthy diets*. Rome, Italy: FAO. pp. 43–75. <http://hdl.handle.net/10568/80578>
- Grace, D. and McDermott, J. 2015. Food safety: Reducing and managing food scares. In: International Food Policy Research Institute, *2014-2015 Global food policy report*. Washington, DC: IFPRI. pp. 41–50. <http://ebrary.ifpri.org/cdm/ref/collection/p15738coll2/id/129080>
- Grace, D., Roesel, K., Kang'ethe, E., Bonfoh, B. and Theis, S. 2015. *Gender roles and food safety in 20 informal livestock and fish value chains*. IFPRI Discussion Paper 1489. Washington, DC: IFPRI. <http://ebrary.ifpri.org/cdm/ref/collection/p15738coll2/id/129860>
- Roesel, K. and Grace, D. (eds). 2014. *Food safety and informal markets: Animal products in sub-Saharan Africa*. London, UK: Routledge. <https://hdl.handle.net/10568/42438>

References

- Copenhagen Consensus. 2017. <http://www.copenhagenconsensus.com/post-2015-consensus/nobel-laureates-guide-smarter-global-targets-2030>
- Eijlander, P. 2005. Possibilities and constraints in the use of self-regulation and co-regulation in legislative policy: Experience in the Netherlands – Lessons to be learned for the EU? *Electronic Journal of Comparative Law* 9(1). <https://www.ejcl.org/91/art91-1.PDF>
- GlobeScan. 2017. *Evaluating progress towards the Sustainable Development Goals*. <https://globescan.com/evaluating-progress-towards-the-sustainable-development-goals/>
- Grace, D. 2016. Influencing food environments for healthy diets through food safety. In: FAO, *Influencing food environments for healthy diets*. Rome, Italy: FAO. pp. 43–75. <http://hdl.handle.net/10568/80578>
- Grace, D. and Unnevehr, L. 2013. *The role of risk assessment in guiding aflatoxin policy*. IFPRI 2020 Focus Brief 20(14). Washington, D.C.: IFPRI. <https://hdl.handle.net/10568/33932>
- Grace, D., Lindahl, J., Wanyoike, F., Bett, B., Randolph, T. and Rich, K. 2017. Poor livestock keepers: ecosystem–poverty–health interactions. *Philosophical Transactions of The Royal Society B* 372(1725): 20160166. <http://dx.doi.org/10.1098/rstb.2016.0166>
- Havelaar, A.H., Kirk, M.D., Torgerson, P.R., Gibb, H.J., Hald, T., Lake, R.J., Praet, N., Bellinger, D.C., Silva, N.R. de, Gargouri, N., Speybroeck, N., Cawthorne, A., Mathers, C., Stein, C., Angulo, F.J. and Devleeschauwer, B. on behalf of World Health Organization Foodborne Disease Burden Epidemiology Reference Group. 2015. World Health Organization global estimates and regional comparisons of the burden of foodborne disease in 2010. *PLOS Medicine* 12(12): e1001923. <http://dx.doi.org/10.1371/journal.pmed.1001923>
- Hawkes, C., Grace, D. and Thow, A.M. 2015. Trade liberalization, food, nutrition and health. In: Smith, R., Blouin, C., Mirza, Z., Beyer, P. and Drager, N. (eds), *Trade and health: Towards building a national strategy*. Geneva, Switzerland: World Health Organization. pp. 92–116. <https://hdl.handle.net/10568/68286>
- HLPE. 2016. *Sustainable agricultural development for food security and nutrition: what roles for livestock?* High Level Panel of Experts on Food Security and Nutrition (HLPE) Report No. 10. Rome, Italy: FAO. <http://hdl.handle.net/10568/76163>
- Humphrey, J. 2017. *Food safety, trade, standards and the integration of smallholders into value chains A review of the literature*. Rome, Italy: International Fund for Agricultural Development. <http://www.fao.org/fsnforum/fr/node/4416>

- Kavle, J.A., El-Zanaty, F., Landry, M. and Galloway, R. 2015. The rise in stunting in relation to avian influenza and food consumption patterns in Lower Egypt in comparison to Upper Egypt: Results from 2005 and 2008 Demographic and Health Surveys. *BMC Public Health* 15: 285. <https://doi.org/10.1186/s12889-015-1627-3>
- McDermott J, Grace D and Zinsstag J. 2013. Economics of brucellosis impact and control in low-income countries. *Scientific and Technical Review* 32(1): 249-261. <http://www.oie.int/doc/ged/D12425.PDF>
- Queenan, K., Garnier, J., Rosenbaum, N., Buttigieg, S., de Meneghi, D., Holmberg, M., Zinsstag, J., Rüegg, S.R., Häsler, B and Kock, R. 2017. Roadmap to a One Health agenda 2030. *CAB Reviews* 12(014): 1-12. <https://doi.org/10.5167/uzh-137464>
- Roesel, K. and Grace, D. (eds). 2014. *Food safety and informal markets: Animal products in sub-Saharan Africa*. London, UK: Routledge. <https://hdl.handle.net/10568/42438>
- USAID (United States Agency for International Development). 2015. *National perception survey*. Hanoi, Vietnam: Mekong Development Research Institute.
- Waage, J., Yap, C., Bell, S., Levy, C., Mace, G., Pegram, T., Unterhalter, E., Dasandi, N., Hudson, D., Kock, R., Mayhew, S.H., Marx, C. and Poole, N. 2015. Governing Sustainable Development Goals: Interactions, infrastructures, and institutions. In: Waage, J. and Yap, C. (eds), *Thinking beyond sectors for sustainable development*. pp. 79-88. London, UK: Ubiquity Press. <https://doi.org/10.5334/bao.i>
- WHO (World Health Organization). 2016. *World Health Statistics 2016: Monitoring health for the SDGs*. Geneva, Switzerland: WHO. https://www.who.int/gho/publications/world_health_statistics/2016/en/
- WHO (World Health Organization). 2017. *World Health Statistics 2017: Monitoring health for the SDGs*. Geneva, Switzerland: WHO. https://www.who.int/gho/publications/world_health_statistics/2017/en/
- WHO (World Health Organization)/UNICEF (United Nations Children's Fund). 2015. *Progress on sanitation and drinking water: 2015 update and MDG assessment*. Geneva, Switzerland: WHO. https://www.unicef.org/publications/index_82419.html



Patron: Professor Peter C Doherty AC, FAA, FRS

Animal scientist, Nobel Prize Laureate for Physiology or Medicine–1996

Box 30709, Nairobi 00100 Kenya
Phone +254 20 422 3000
Fax +254 20 422 3001
Email ilri-kenya@cgiar.org

ilri.org
better lives through livestock

ILRI is a CGIAR research centre

Box 5689, Addis Ababa, Ethiopia
Phone +251 11 617 2000
Fax +251 11 667 6923
Email ilri-ethiopia@cgiar.org

ILRI has offices in East Africa • South Asia • Southeast and East Asia • Southern Africa • West Africa



This publication is licensed for use under the Creative Commons Attribution 4.0 International Licence.

June 2017