



Global Panel
on Agriculture
and Food Systems
for Nutrition

ASSURING SAFE FOOD SYSTEMS: Policy Options for a Healthier Food Supply

This policy brief reviews food safety issues that are critical to poor and vulnerable populations in low- and middle-income countries, with a particular focus on their impact on healthy diets. An integrated set of policy actions, including regulation, surveillance, and training of individuals and organisations involved all along the food chain, is required to assure the safety of food systems and to support a healthier food supply.

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ABOUT THE GLOBAL PANEL ON AGRICULTURE AND FOOD SYSTEMS FOR NUTRITION:

The Global Panel is an independent group of influential experts with a commitment to tackling global challenges in food and nutrition security. It works to ensure that agriculture and food systems support access to nutritious foods at every stage of life.

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Executive Summary

Food can be unsafe for human consumption if it causes illness, negatively affects nutritional status and growth, and/or results in avoidable mortality. While no consumer deliberately eats unsafe food, except in extreme situations of famine, millions of people unknowingly challenge their nutrition and health every day by eating food that carries serious risks. Detecting the presence of the agents that make food unsafe is not straightforward. Harmful bacteria, viruses, natural toxins, and chemicals may be present as chemical residues or carried in the matrix of food itself but remains invisible to the naked eye. Food safety policy, regulation and surveillance are therefore fundamental challenges for governments which seek to enhance the dietary quality and nutrition of their citizens.

Food systems are rapidly changing, bringing greater attention to issues of food safety. Growing international connectivity of food markets involves the lengthening of supply chains and a proliferation of actors involved in bringing food from the farm to the consumer. Consequently, the detection and elimination of foodborne risks is becoming both more complex and more difficult. The health of the world’s rapidly expanding urban populations, reliant on supply chains in which products are in transit, storage, and the processing pipeline for weeks or months, depends on appropriate actions along the entire supply chain.

Concerns about sanitary and phytosanitary standards (SPS) related to food are central to many trade negotiations and agreements, although food safety regulation and mitigation are responsibilities shared by the public and private sectors. At the production end of the supply chain, poor field and crop storage environments in most low-income tropical environments

are conducive to the growth of dangerous natural toxins. They are currently poorly controlled in the food chain, and climate change is expected to make their control even more difficult in the future.

“As the world faces significant food security problems, food safety is likely to gain even more prominence as a global issue through 2025.”

US National Intelligence Council'

In most cases, neither producers nor consumers have the tools to enhance the quality and safety of their food. Since unsafe food may have more significant long-term impacts on human health and nutrition than previously thought, policy action is urgently needed. Health concerns have traditionally focused on readily-measured impacts of foodborne diseases, such as diarrhoea, raised blood levels of harmful substances, and death. However, new data are uncovering more complex, long-term impacts that potentially include child stunting and even adult obesity.

This Policy Brief reviews food safety issues that are critical to poor and vulnerable populations in low- and middle-income countries. Assuring the safety of global food systems will require coordinated actions across policy, regulations, surveillance, and control measures to reduce the risk of foodborne illness. Every government needs to pay close attention to these issues and invest in the appropriate steps, from production through to consumption.





Introduction

Food safety has traditionally been seen as a public health or medical matter, but is increasingly being recognised as an important issue for agriculture and food systems. Food safety affects trade, rural incomes and purchasing power, worker productivity, and consumer confidence. It poses new challenges, not only to policymakers but also producers, marketing agents, and consumers. Food safety in the future will require ever-closer coordination among researchers, policymakers and private sector actors dealing with agriculture, nutrition and health.

Unsafe food contains or carries hazards that have the potential to have a negative impact on nutrition, to damage health, and/

or cause death.^{2,3} Box 1 presents some examples of food safety hazards widely prevalent in food systems.

Hazards can arise throughout the food system. They can have immediate effects on food consumers, through food poisoning as well as longer-term impacts, for example causing cancer or impairment of child growth. Guidelines addressing Hazard Analysis and Critical Control Points (HACCP) have been issued by the Food and Agriculture Organization of the United Nations (FAO) pursuant to adoption by the Codex Alimentarius Commission. These guidelines have been developed through an international process of data-gathering, and they cover the entire food and agriculture system.

However, essential information on the presence of foodborne pathogens in various segments of the food supply chain, on levels of consumer exposure, and on potential health and nutrition impacts is lacking, particularly in low- and middle-income countries.⁵ Steps to remedy these gaps are being taken. For example, the FAO and the World Health Organization (WHO) have recently worked with the governments of Sudan, Ethiopia, Mali and Burkina Faso to generate data on mycotoxin contamination in sorghum which will contribute to Codex standards.⁶

Some food safety hazards originate at the point of production. For instance, crops grown in fields with arsenic-contaminated groundwater contain levels of arsenic that can be damaging to human health when consumed.⁷ Some crops, for example maize, groundnuts and sorghum, can be contaminated with harmful mycotoxins arising from moulds present in crops on farmers' fields or emerging as a result of sub-optimal storage. Mycotoxins can

It would be disastrous if the food at the centre of our lives were to become unsafe for consumption. Much needs to be done to prevent this, and we can begin by aligning policies in agriculture, trade, health, education, and social protection to provide a safe and healthy diet for all.

Margaret Chan, Director General of WHO¹⁰

cause death, either through acute aflatoxicosis or in the longer run through cancer.⁶ Milk produced by cows infected with pathogens such as *Salmonella* or fed mycotoxin-contaminated feed may be unsafe and also cause illness to consumers drinking raw milk.⁸

Other hazards can be introduced during food storage and transportation or in the processing and retailing of food.^{6,8} Poor sanitary facilities in warehouses, markets, and households may lead to contamination of food by infected food handlers.⁸ Flies and other insects or rodents may spread pathogens to food. Unsafe water used in washing or processing foods such as fruits and vegetables can also be an important source of contamination.

The WHO's 2015 report on the global burden of foodborne disease synthesises existing scientific evidence on health outcomes associated with various foodborne hazards. It provides the first estimate of global foodborne disease incidence, mortality and disease burden (the latter in terms of Disability Adjusted Life Years (DALYs)). The estimates cover 31 foodborne hazards, of which

28 were biological and three chemicals. Together they caused 600 million cases of foodborne illnesses and 420,000 deaths in 2010. Forty percent of the foodborne disease burden was among children under five years of age.⁵

Food safety is an area of particular concern for low- and middle-income countries where regulatory, surveillance, and control systems are unable to address the range of potential hazards. The regions most affected by the burden of foodborne diseases are Africa, followed by South-East Asia, with marked sub-regional variations. People living in low-income sub-regions are likely to bear the greatest burden for a number of reasons including unsafe water used for cleaning and processing food; poor agricultural practices; poor food handling, including the inappropriate use of agricultural chemicals; the absence of adequate food storage infrastructure; and, perhaps most importantly, no access to alternative foods when staple crops, such as maize, are contaminated.⁵

With growing international concern over unsafe food, it is important that policies in agriculture and the food system are designed to ensure both the nutritional quality and the safety of the foods we eat. This policy brief takes a systems approach consistent with HACCP and is directly linked to the food environment model advanced by the Global Panel in its 2014 Technical Brief "How Can Agriculture and Food System Policies Improve Nutrition?"⁹ This approach helps to identify opportunities for policy coherence and synergy across these important and related goals. Recommendations are provided for policymakers on actions that should be taken to promote food safety, dietary quality and good nutrition simultaneously.

Food Safety Burden

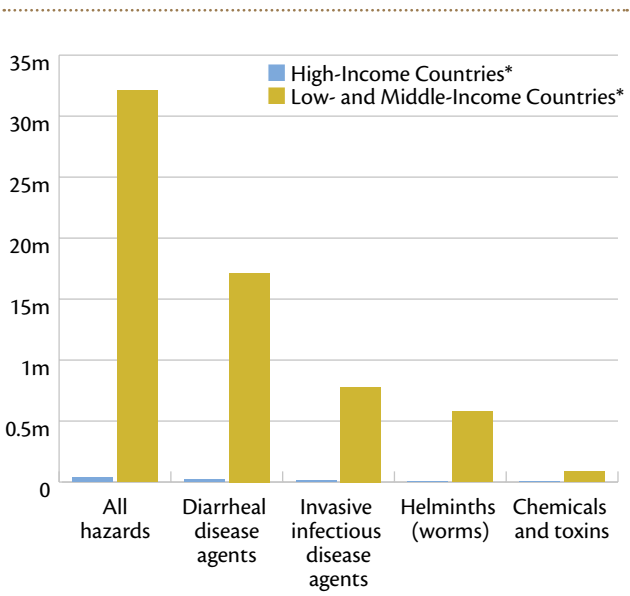
The 2015 WHO report suggests that, on a global scale, the greatest foodborne disease burdens (DALYs) are associated with diarrhoeal disease agents, followed by invasive infectious disease agents, helminths (worms) and chemicals and natural toxins (see Figure 1). In particular, children under five years of age are highly susceptible to foodborne diseases and account for almost one third of all food contamination-related mortality, although they make up only 9% of the world's population.⁵ While this report reveals the substantial burden of foodborne threats to health, it also stresses that "the burden of foodborne diseases to public health and welfare and to the economy has often been underestimated due to underreporting and difficulty in establishing causal relationships between food contamination and resulting illness or death."¹¹ The true burden may be greater, particularly in low- and middle-income countries where reporting is limited.

The WHO calculations focused on specific health outcomes, mainly the morbidity, mortality and costs of treating major foodborne diseases. They did not include "the effects of foodborne diseases on malnutrition".⁵ The current state of knowledge does not allow accurate estimations of the global foodborne burden on nutritional outcomes such as anaemia⁵, for example, which is a leading cause of DALYs lost globally and a major individual contributor to the Global Burden of Disease.¹³

Similarly, the effects of immune deficiency and gut permeability linked to pre-existing undernutrition were not factored into the WHO calculations. This is important as there is some evidence that aflatoxins might contribute to child growth retardation or wasting, maternal anaemia and low birth weight babies.^{14, 15, 16, 17} The burden of disease associated with aflatoxins in the WHO study was estimated solely on the basis of its contribution to cancers in adults. Measuring the impact of foodborne diseases on malnutrition and its associated health conditions represents a critical research priority for the future. That said, existing evidence of strong associations between food safety hazards and poor nutrition, discussed below, already offers governments



Figure 1: Global Burden of Foodborne Disease (DALYs)



*Data source: WHO Estimates of the global burden of foodborne diseases online tool¹². The WHO classifications for the regions were based on child and adult mortality. For the purpose of this policy brief, regions are categorised as (i) high-income countries and (ii) low- and middle-income countries according to the World Bank (WB) classifications. The High Income Countries group in Figure 1 include high income countries plus Cuba (WB classification is middle-income).

and businesses a basis for defining context-specific interventions to reduce important food safety threats.

The economic burdens of foodborne diseases are even less well understood. The estimated costs of treating foodborne diseases themselves vary widely, but are, in general, significant.¹⁸ Much more difficult to determine are estimates of the fiscal costs borne by farmers, herders, and fishing communities in the form of lost incomes when their products are deemed unsafe and cannot be marketed. Commodities that enter into global trade are generally more tightly regulated with regard to food safety standards. They can be rejected at any point throughout the supply chain. When producers do not have the tools or knowledge to remedy or manage identified food safety hazards, they can face a total loss of livelihood and their own food and nutrition security may be threatened.

Surveillance of food systems through publicly-funded inspection and testing services is essential to ensuring that agents in the food value chains are compliant with policies and regulations and that the risks of foodborne diseases are managed effectively. In low- and middle-income countries, establishing institutions that have the scientific capacity as well as adequate operating resources to manage effective surveillance of food safety has proven difficult, even when it is essential to sustaining trade in key markets.¹⁹

Why Food Safety Matters to Nutrition

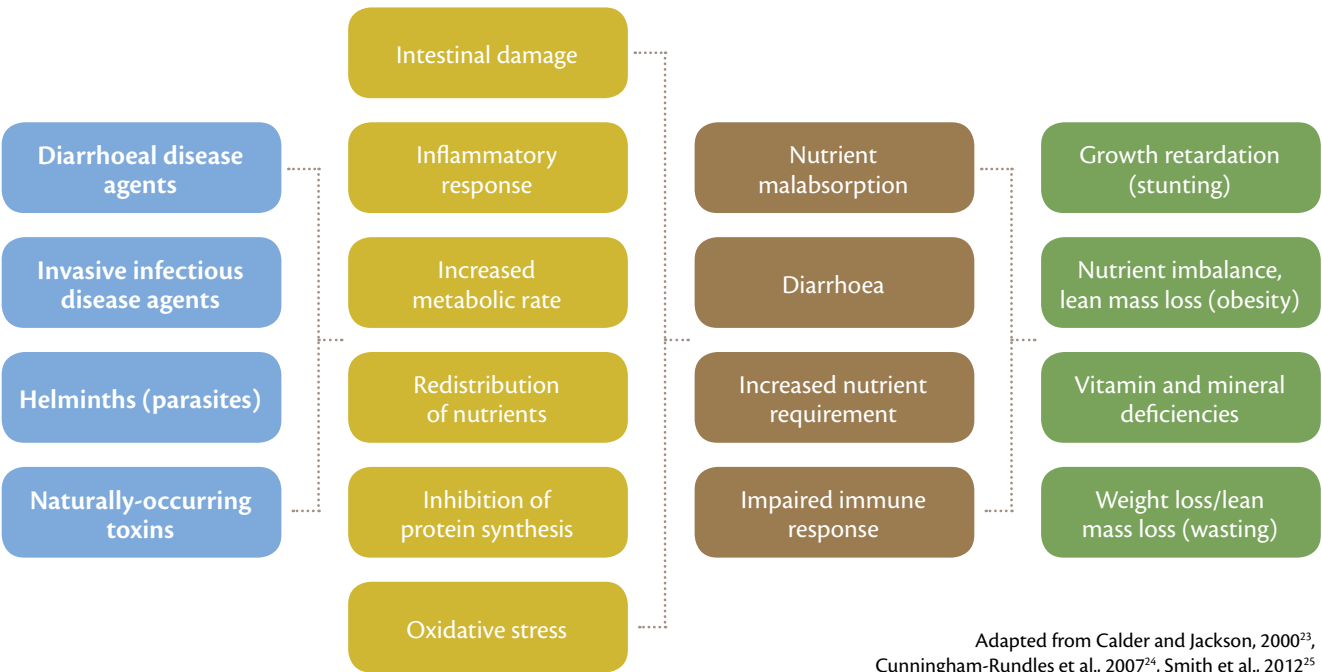
Food safety hazards are associated with many foods that are important to high quality diets. Globally, much of the known burden of foodborne disease comes from consumption of fresh, perishable foods sold in informal markets of developing countries, where a lack of storage and cooling facilities can jeopardise food safety.^{8, 20} Micronutrient-dense foods such as vegetables, fruit, meat and dairy are at particular risk of being contaminated by micro-organisms associated with foodborne diseases. Gastrointestinal illnesses are the most common manifestation of foodborne disease, and are particularly associated with undercooked meat, eggs, fish, fresh produce and dairy products. Diarrhoeal diseases are responsible for causing 230,000 deaths of which 96,000 are children under five years.⁵

Unsafe food can affect nutrition and health outcomes both directly and indirectly. Figure 2 illustrates some of the pathways by which foodborne disease agents can affect nutritional outcomes. Infection by foodborne pathogens can result in poor absorption of nutrients from food, particularly of vitamins and minerals, which have an impact on the consumer's nutritional status.^{21, 22}

Undernutrition and associated immune deficiencies can also increase an individual's susceptibility to infection. Foodborne pathogens take advantage of weak immune systems, particularly affecting infants and young children, pregnant women, the elderly, the malnourished and the immunocompromised. Reinforcing each other in this way, the combination of foodborne



Figure 2: Conceptual diagram of foodborne hazard links to health and nutrition



Adapted from Calder and Jackson, 2000²³, Cunningham-Rundles et al., 2007²⁴, Smith et al., 2012²⁵

disease and undernutrition can spiral into a vicious cycle of worsening health, with particular impact on vulnerable early life stages where poor nutritional outcomes can lead to stunted growth, carrying a lifetime of consequences.^{5, 23, 24}

The nutritional impacts of foodborne disease agents that cause diarrhoea have been known for many years. Diarrhoea has a clear effect on weight loss, loss of appetite, loss of key micronutrients, such as zinc and iron, as well as wasting and growth retardation. Some of the physiological mechanisms involved in response to foodborne pathogens may also play a part in overweight and obesity. The chronic inflammatory responses, redistribution of nutrients, inhibited protein synthesis, rising oxidative stress, nutrient malabsorption, impaired immune response and increased nutrient requirements associated with foodborne pathogens have all also been associated with obesity.^{26, 27, 28}

While much more needs to be understood about gut function, metabolism disturbance and immune system impairment in relation to obesogenic processes in the body, initial data suggests that applying a nutrition lens to the issue of food safety should strengthen our focus on diet quality.^{23, 24, 25, 26, 27, 28}

Recently, attention has focused particularly on consumers' exposure to mycotoxins, which are known to be harmful to human health, causing acute poisoning and even death when contamination levels are very high as well as, over longer periods of time, liver cancer.^{29, 30, 31, 32} There are a range of forms of mycotoxins, of which the most dangerous are aflatoxins, ochratoxins and Fusarium toxins. Because of their presence on widely-consumed foods, high rates of dietary aflatoxin exposure are found across Africa and Asia, particularly where dietary diversity is low and reliance on staples is high.^{5, 33}

As noted earlier, recent research indicates that aflatoxin-contaminated food may also lead to stunting and growth impairment in children, not only reducing their chances of long and productive lives, but perhaps also making them more susceptible to other illnesses. Khlangwiset et al. (2011) argue that “among the risk factors associated with growth impairment, aflatoxin emerges as playing a potentially important contributory role. The weight of evidence linking aflatoxin with growth impairment has been increasing over the last five decades of research.”¹⁵ Similarly, Leroy et al. (2015) report that “observational studies conducted in West Africa have documented an association between AflatoxinB1 exposure and stunted foetal, infant and child growth.”¹⁷

Expanded efforts to reduce exposure to mycotoxins in general, and aflatoxin specifically, have brought together researchers from many disciplines. The Consultative Group for International Agricultural Research (CGIAR) has formed a Working Group focused on mycotoxin control in low- and middle-income countries and recently published a paper summarising findings to date.³⁴ The African Union Commission hosts the Partnership for Aflatoxin Control in Africa (PACA) to advance policies and strategies across the continent to protect crops, livestock and people from the harmful effects of aflatoxin.^{35, 36}

A report by the International Agency for Research on Cancer (IARC) in the WHO concluded that, taken together, the few well-documented population based studies and the mechanistic data from relevant animal models suggest that mycotoxins contribute to child stunting independent of, and with, other risk factors.¹⁴ This kind of evidence requires us to pay attention not only to the adequacy and diversity of diets, but also to the quality of diets with regard to the presence or absence of multiple forms of food contaminants.



Integrated actions to improve food safety and nutrition

Recognising the potential harmful impacts of foodborne contaminants in food systems, most governments pass laws and regulations regarding national food safety and maintain institutions tasked with surveillance and control. International laws and regulations govern food safety in trade that goes beyond national borders. Protecting consumers from unsafe food would seem to be a commonly-shared public policy goal. Actions taken to achieve that goal, however, often prove to be less effective than expected and may in fact have unintended consequences for consumers and their nutrition and health.

For example, if public inspection services or a private marketing agent identifies crops and foods as not meeting food safety standards, producers of those unsafe products often have little recourse. If they are not allowed to market the product, producers will suffer an immediate decrease in income, possibly affecting their livelihoods and their own access to nutritious foods. Market rejection may lead to increased home consumption of unsafe food or alternatively, consumption by livestock so that the contaminant may still enter through a different part of the food system.^{20, 37, 38}

Compliance with food safety standards, whether national or international, can be costly for small producers and may restrict their access to higher value markets which have potential to improve income and reduce poverty.^{8, 20, 38} The history of aflatoxin contamination in the global cereal and groundnut trade shows the scope of the impacts that can be realised.^{39, 40, 41} Not only has the value of groundnut exports by West African producers been decimated, but exporters' rejection of groundnuts from Malawi due to high aflatoxin levels resulted in that food being sold cheaply in local markets.⁴² In the 1960s, Africa, particularly West Africa, dominated the groundnut market with a 77% share, but by the turn of this century it had fallen to around 4%. Given a market valuation of about \$1.6 billion, that equates to a loss in earnings of around \$1.2 billion.⁴³ In the European Union (EU), there has been a significant number of border refusals of food imports due to non-compliance with food safety standards. Between 2008 and 2013, fruit and vegetables alone represented about 20% of all EU food export refusals, largely due to the violation of pesticide residue limits.⁴⁴

Ensuring safety and improved nutrition in food systems warrants a cross-sectoral integrated approach that goes beyond regulations and standards. An integrated approach requires multidisciplinary research spanning agriculture, economics, nutrition, and health to identify the full costs and extent of foodborne diseases and to guide the development of cost-effective measures to mitigate or eliminate hazards in food supply chains. Mechanisms for testing foods at various points in the supply chain and providing information to consumers, for example, regarding sufficient heating of foods to kill pathogens, must be introduced and monitored for compliance. Institutional capacities for understanding and managing food safety risks

“Improvements should be made to food safety along the entire food chain, from production to storage, transportation, and processing. It is important to recognize, however, that if improving food safety raises the cost of food, it may threaten the food security of the poorest people.”

Per Pinstrup-Andersen, Professor Emeritus, Cornell University²¹

will, of necessity, involve both public agencies (in areas ranging from trade policy to healthcare) and private organisations participating in the various segments of the supply chain.

Given that food safety is an integral part of international trade in food, integrated country, regional and continental standards are the ideal solution for some food safety issues. As the Codex Alimentarius process has demonstrated, it may be advantageous to coordinate data collection, research, and the development of interventions for action on a regional level. But more specific actions may also be useful. For instance, in light of the African aflatoxin burden and restrictions to trade arising from food safety standards related to aflatoxin, PACA was established to coordinate aflatoxin mitigation across the health, agriculture and trade sectors across the continent, as well as to help establish information management systems (for example Africa AIMS – Aflatoxin Information Management System) and laboratory testing facilities.³⁶

In preparing national regulatory frameworks, countries can consider existing international, regional and sub-regional standards and regulations and adapt them to their context. Sound national governance and appropriate food safety surveillance systems across the food chain are essential for translating standards and regulations into effective systems for controlling foodborne pathogens.³³

National and local measures across the food system

Food safety involves all domains of the food system, from on-farm production through marketing and processing to consumers' own actions. The considerable difference in the health burden attributed to contaminated food that exists between low- and high-income countries suggests that a large proportion of foodborne diseases are avoidable.⁵ Identifying points where prevention is most effective can concentrate efforts to minimise the negative impacts. However, it is essential to adopt a 'whole food chain' approach in food safety strategies and measures, as recommended by the FAO and WHO.^{38, 45}



Measures to Improve Food Safety in the Food Production Domain

Application of appropriate measures by food producers can contribute to reduced foodborne threats to the nutrition and health of the farming households themselves as well as for buyers and consumers in the post-farm gate segments of the food chain. Given the importance of own production to smallholders' diets, improving the safety of food production practices must be a fundamental policy goal for governments. However, with rising levels of urbanisation and global trade, the use of production technologies and practices to ensure that safe as well as nutritious products are entering the food supply chain is a prime concern.

Growing demand for fruit and vegetables is often met with a production response involving irrigation. Water used for irrigation can be contaminated with disease-causing bacteria, viruses, protozoa and helminths.⁴⁶ While groundwater is generally safe, crops grown with surface runoff and human wastewater are often at risk of contamination. Wastewater use in farming is increasing due to the rising scarcity in irrigation water, particularly in peri-urban areas.⁴⁷ It is clear that poor sanitation in the food system generates serious food safety concerns. Some studies also suggest that pathogens may be transferred to produce in markets through poor hygiene practices.^{48, 49, 50}

The appropriate application of pesticides, herbicides, and other chemicals in crop production processes is another area of concern. There are well documented health effects of occupational exposure to pesticide application to crops. However, the potentially adverse health consequences from dietary exposure remains poorly characterised.^{51, 68} The health impact of chemical residues on crops are related to their concentration, their toxicity or other health effects, and the age of the consumer, with children being more sensitive than adults. Many pesticides developed over the past fifty years are now banned because of negative health effects, but in the absence of effective regulatory enforcement, some may still be available to farmers in low- and middle-income countries. However, farmer training in integrated pest management has proven effective in reducing the use of pesticides on a wide range of crops.⁵²

Research on the management of on-farm aflatoxin contamination illustrates how an integrated approach to crop management can reduce the presence of this dangerous toxin in the food supply. Smallholder production practices,

such as optimal timing of harvesting, crop rotation, sound use of fertilisers, and use of a biological control application that suppresses the activity of mycotoxin-producing fungi can all contribute to reducing aflatoxin contamination in the commodity that is harvested. Improved crop drying and storage strategies can also reduce aflatoxin levels.⁶ A project to test better aflatoxin control in farmers' fields in Nigeria is combining technical innovation, including biological control with incentives for adoption, for example, promoting farmers' groups, creation of premium markets and supportive policies.³²

The intensification of livestock production, in response to a growing demand for animal-source foods, particularly in middle-income countries, is generating food safety concerns. Intensive livestock production relies on the use of antimicrobial drugs, and antimicrobial resistance (AMR) in livestock is growing. This is posing a risk that movement of resistant bacteria or resistance genes from animals to humans may exacerbate the already serious problem of AMR in humans. Intensive research is underway on AMR internationally, but evidence on this potentially serious food safety problem is currently limited, particularly in low- and middle-income countries.^{53, 54}

Measures to Improve Food Safety in the Trade and Markets Domains

As food produce moves from farm to market, conventional food safety approaches focus on more 'formal' channels and the application of regulations. The formal food sector is operated by licensed, well-capitalised, and, often, national or international firms who manage different segments of the post-farm gate value chain, including wholesalers, processors and commercial retail shops and supermarkets. For marketing agents in the formal sector, food safety is a critical aspect of their business as their reputations, consumer loyalties, and continued operations depend on it. It is widely believed that the formalisation of markets, which include an improved capacity for refrigeration, food hygiene and storage and regulation of standards, improves the safety of food.^{45, 55} However, this is not always the case in low- and middle-income countries.⁵⁶

Informal markets tend to be dominated by individual traders or trade associations who work in various segments. These encompass collecting commodities from producers, wholesaling in spot markets, and providing retail services for both fresh or only semi-processed foods as well as highly-processed, ready-to-eat items, such as street foods.^{8, 55} Actors in informal

markets rarely have formal training in food safety, and few are aware of regulations that might apply to their activities.

Developing low-cost testing methods that will work in rural conditions is important to adoption of farmgate measures which prevent entry of food safety hazards into both informal and formal food supply chains.⁶ When marketing agents in the formal sector are able to test for contaminants, they are likely to reject shipments that do not meet current food safety standards.

Since poor households, whose dietary quality is already low, also depend largely on informal markets for their food, their chances of acquiring food that poses food safety hazards are probably high. While implementation of safety standards in such contexts could achieve the desirable aim of improving health outcomes, the additional financial and informational costs associated with accessing safe food may actually be too great a burden for the poor. The International Livestock Research Institute (ILRI) attempts to address such food safety and informal market trade-offs in their "Safe Food, Fair Food" project. Researchers find, for example, that poor Kenyan families normally boil their milk before consumption, thus reducing the hazard of unpasteurised fresh milk to a much lower level of risk.³⁸

While standards for products in formal markets, and especially in international markets, are relatively well-publicised and clear, improving food safety in informal markets can be challenging. There is, however, promise in participatory approaches that engage informal food traders and vendors directly, offering gradual improvements and an inclusive path to formalisation.^{38, 56}

In 2011, the government of Vietnam revised food safety laws to address the safety of street food for both vendors and consumers and committed to providing training on hygiene and food safety.⁵⁷ In Kenya, a scheme to train and legitimise dairy traders led to benefits for farmers, vendors and consumers.⁵⁶ Previous policies that placed restrictions on informal markets had hindered the uptake of improved technologies among traders and producers. After a minor revision of the dairy policy in 2004, small-scale milk vendors were able to access a training and certification scheme as a means of assuring milk safety and



“ Food systems are evolving, giving rise to new food safety challenges. Assuring a safe food supply requires the highest level of political commitment to strengthen national systems. This is especially important for Africa and other developing countries. ”

Akinwumi Adesina, President,
African Development Bank

quality and market access. Subsequent evaluations have showed that trained vendors now produce safer milk and there are substantial benefits to the national economy.^{33, 56, 58}

In general, food safety improvements are possible in markets where incentives exist. Unaffordable and inaccessible measures and testing equipment can be a barrier unless supported by investment in the necessary resources and manpower.

Measures to Improve Food Safety at the Consumer Level

Consumers, of course, can have a great impact on the quality of food sold to them by asking for more nutritious and safer food choices. In articulating these demands, they act as "agents of quality control". Perhaps more importantly, however, the way that consumers handle the foods they eat within the confines of their own homes also determines its safety: how it is washed, how utensils are cleaned, whether the food is properly chilled or heated, how it is stored. For maximum reduction of foodborne hazards, consumers must be aware of the basic principles of food safety, understand the linkage between food quality, handling, and health outcomes, and be able and willing to apply good practices, such as handwashing during food preparation, reaching necessary cooking temperatures and maintaining clean workspaces.

Programmes to change food hygiene behaviour have the potential to improve health outcomes, particularly the reduction of childhood diarrhoea and malnutrition.⁶⁰ They may involve integrating community level training in agricultural practices with household level hygiene and nutrition programmes.⁶¹

Studies have found that consumers in low- and middle-income countries say they are willing to pay more for safe food.⁵⁹ However, as a practical matter, consumers may have few ways beyond visual inspection of identifying whether a food is safe. Trust in the capacities of national organisations for food safety oversight to ensure the safety of food is often problematic. There are few examples of credible third party certification regarding food safety.^{33, 56, 58} Consumers use brand names as a sign of quality and safety (or not), employ food preparation and cooking techniques to reduce pathogens, and respond to signals regarding food safety heard in the community or marketplace. Surveys, however, show that many consumers' knowledge of foodborne pathogens and foodborne diseases is limited and that practices related to food hygiene in preparation and storage are not always safe.^{62, 67}

Recommendations to Policymakers

It is increasingly recognised that food safety is a significant threat not only to public health but also to income, trade and nutrition. The broad impacts of foodborne hazards argue for integrated solutions across the entire food system. A comprehensive and integrated set of policy actions backed up by regulation, surveillance, and training of individuals and organisations involved in all segments of the food environment are required to assure the safety of transforming food systems and to support a healthier food supply.

This Policy Brief has outlined the importance of food safety policy measures across the food system, with a particular focus on their integration with improved nutrition. While improving consumer nutrition and health, some food safety policies may have unintentional negative effects on food security and nutrition, particularly in poor communities. The Global Panel recommends that policymakers consider:

Actions across the Food System

- **Integrate food safety policymaking with agriculture and nutrition policymaking to achieve greater policy coherence.** A national commitment to healthy and safe food systems goes beyond regulations; it requires attention by public and private sector actors to the quality (safety, diversity and nutritional adequacy) of foods at all steps of the food chain. Policy actions should be informed by evidence on the severity of hazards, economic costs and the nutritional impacts, particularly in vulnerable groups. Global regulation of trade in food products should seek to enhance national capacity to meet appropriate standards.
- **Strengthen national research on the full extent and cost of foodborne diseases and the effects on malnutrition.** This should include increased international research on the role of mycotoxin exposure on key nutritional mechanisms and outcomes.
- **Strengthen food safety information systems, taking into account the different segments and actors of the food systems.** Policymakers should take into account access to timely, quality information on the food safety situation.
- **Establish context appropriate national regulatory frameworks that integrate strengthening of human, institutional and systemic capacities for food safety control at national and decentralised levels.** These should take into account the roles of farmers, trading and farmer organisations, agricultural researchers, public health and nutrition practitioners. The complex nature of food safety means a holistic and multidisciplinary approach is needed. The entire food system needs to share the cost of food safety interventions as the poorest in the supply chain cannot bear the cost alone.

Actions in the Food Production Domain

- **Provide support in the production domain of the food system, for example, advice on good manufacturing processes and support for high quality agricultural input.** Safe and nutritious food outputs demand higher quality seeds and animal stock, access to quality inputs, and learning and adoption of good management practices in all facets of agriculture.
- **Efforts by governments to better understand the extent and nature of the sources of contamination of their domestic food supply, with for example mycotoxins and harmful pesticides.** They should promote enhanced awareness and application of practices to prevent and mitigate such hazards. Governments should establish appropriate protocols for protecting poor consumers from eating commodities rejected by exporters due to high contamination levels.
- **Promote improved knowledge and practices related to on-farm storage of agricultural products known to be prone to food safety hazards.** Numerous innovations in materials, for example, in storage bin and sack technology, should be explored and promoted in the relevant context.

Actions in the Trade and Markets Domain

- **Enhance the timeliness of trade in perishable foods through investment in road infrastructure, regional warehousing and improved information systems relating to market prices.**
- **Support inclusive and progressive formalisation of markets, providing the necessary resources and manpower while improving the market incentives for food safety and quality management.** Informal markets support the livelihoods of producers and traders and increase the availability of nutrient-dense foods to nutritionally-insecure households. Approaches such as voluntary training and certification schemes can help the formalisation of the sector.
- **Improve storage facilities, reducing perishability through cold chain and other storage technologies as well as effective quality control.**

Actions in the Consumer Domain

- **Support enhanced consumer awareness of the importance of food safety in ensuring access to high quality diets.** This may take the form of public information campaigns and a greater focus on community-level nutrition education efforts on food safety as a diet quality and nutrition concern.
- **Promote and support greater dietary diversification with a view to reducing exposure to some foodborne contaminants, while also enhancing diet quality.**
- **Promote greater public awareness of the importance of food handling and storage, particularly in relation to nutrient-dense foods, such as meat, dairy, fruits and vegetables.**

Box 2: Aflatoxins

Mycotoxins present one of the most challenging food safety issues. They affect some of the most commonly consumed staples in Africa and Asia, such as maize, groundnuts, and sorghum. Unlike most food safety issues which impact a particular segment of the value chain, for example harvesting or processing or food preparation, mycotoxin contamination starts with production but can present itself later in the food chain. While a crop may be safe immediately after harvest, three months later it can be unsafe due to poor drying or storage. Reducing the risk of aflatoxin requires governments to build a food safety infrastructure which can handle these diverse challenges and provide an effective base for addressing other food safety issues.

High levels of aflatoxin in humans have been shown to be associated with numerous nutritional impacts ranging from maternal anaemia in pregnant women, to low birth weight babies and child stunting, in addition to impacts on potentially fatal aflatoxicosis and liver cancer.^{15, 63, 64} Generally, higher levels of aflatoxin are associated with raised levels of the adverse nutrition outcome. Infants and young children are particularly at risk when they are introduced to complementary foods at six months of age. These foods often consist of maize porridges, with recommendations to add groundnut powder to improve nutrient density.⁶⁵

A recent nationally-representative survey of diets, nutrition and aflatoxin levels in Timor Leste (which has one of the highest rates of stunting in the world) found that among children aged six to 59 months old “prevalence of detectable aflatoxin exposure was very high” in 83% of the sample. It was

also found that “stunting prevalence was significantly higher among children...who had detectable concentrations of aflatoxin in the blood.”⁶⁶

A recently released report by the IARC, part of the WHO, concluded that, taken together, the few well-documented population-based studies and the mechanistic data from relevant animal models suggest that mycotoxins contribute to child stunting independent of, and with, other risk factors. Using public health criteria, the study assessed 15 interventions and recommended 4 as having sufficient positive evidence for implementation:

- 1 promoting dietary diversity to reduce consumption of contaminated staples;
- 2 grain sorting;
- 3 a package of postharvest measures to improve drying and storage; and
- 4 specific food preparation changes, such as optimised nixtamalisation (boiling maize with lime) as used in Latin America.¹⁴

In short, aflatoxins are a particular food safety challenge. Contamination can be widespread and, once identified, contaminated crops should be removed from the supply chain leading to human consumption. Given the prevalence of aflatoxin in staples, alternative food sources should be made available to food-insecure populations if they are to avoid contaminated food. However, the difficulties in offering food substitutes indicate that preventing field-based infections with aflatoxin and taking steps to reduce toxin development in food storage and handling are critically important.

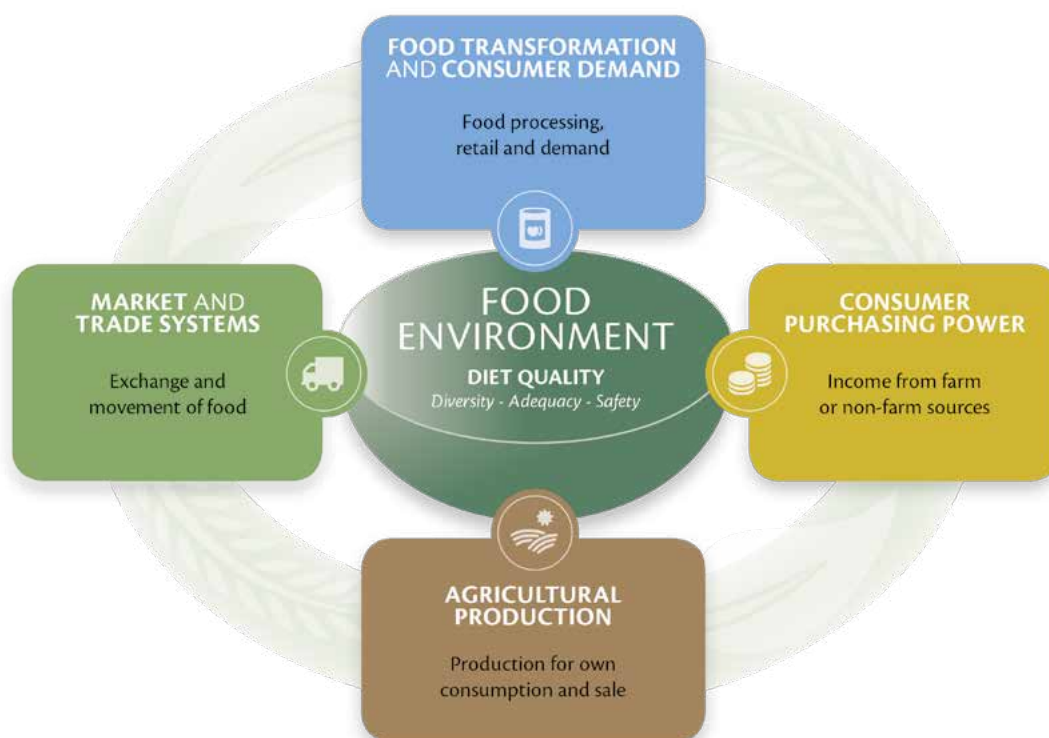
References

1. National Intelligence Council, *Global Food Security*. 2015 Intelligence Community Assessment ICA 2015-04. Washington D.C.
2. FAO and WHO, *General principles of food hygiene*. CAC/RCP 1-1969. [cited 30 November 2015]. Available at <http://www.codexalimentarius.org/standards/list-of-standards/en/?provide=standards&orderField=fullReference&sort=asc&num1=CAC/RCP>.
3. Unnevehr, L. and Hirschhorn, N, Food Safety Issues in the Developing World. 2000. World Bank Technical Paper No. 469.
4. FAO, Food safety risk analysis- A guide for national food safety authorities. FAO Food and Nutrition Paper 87. 2006. Rome.
5. WHO, *WHO estimates of the global burden of foodborne diseases*. Foodborne diseases burden epidemiology reference group 2007-2015. [cited 14 December 2015]. Available at http://www.who.int/foodsafety/publications/foodborne_disease/fergreport/en/.
6. Unnevehr, Laurian J., ed.; Grace, Delia, ed., *Aflatoxins: Finding solutions for improved food safety*. 2020 Vision Focus 20. Washington, D.C.: International Food Policy Research Institute (IFPRI) 2013.
7. Murcott, S., Arsenic contamination in the World: An International Sourcebook. 2012
8. Roesel, K., Grace, D., (eds). *Food safety and informal markets- animal products in sub-Saharan Africa*. 2015. Routledge Taylor & Francis Group, earthscan from Routledge, ILRI.
9. Global Panel, How can Agriculture and Food System Policies improve Nutrition? 2014. Technical Brief, London UK: Global Panel on Agriculture and Food Systems for Nutrition.
10. Chan, M., *Food safety must accompany food and nutrition security*. The Lancet, 2014. 384: 1910-1911.
11. WHO. *Food Safety*. 2015 World Health Organization Factsheet No. 399.
12. WHO. *Estimates of the global burden of foodborne diseases: Online tool*. [cited January 25 2016]. Available at http://www.who.int/foodsafety/areas_work/foodborne-diseases/ferg/en/
13. Kassebaum NJ et al., *A systematic analysis of global anemia burden from 1990 to 2010*. Blood, 2014. 123(5):615-624.
14. Wild, C.P et al. Mycotoxin control in low- and middle-income countries. 2015. Lyon, France: International Agency for Research on Cancer (IARC Working Group Report No. 9).
15. Khlangwiset, P., Shephard, G.S. and Wu, F., *Aflatoxins and growth impairment: a review*. Critical Review in Toxicology, 2011. 41(9): 740-755.
16. Shuaib F. M. B. et al., *Association between birth outcomes and aflatoxin B1 biomarkers blood levels in pregnant women in Kumasi, Ghana*. Tropical Medicine and International Health, 2010. 15 (2): 160-167.
17. Leroy, J.L et al., *Serum aflatoxin B1-lysine adduct level in adult women from Eastern Province in Kenya depends on household socio-economic status: A cross sectional study*. Social Science & Medicine 2015. 146.
18. McLinden, T., *Component costs of foodborne illness: a scoping review*. BioMed Central Public Health, 2014. 14:509.
19. Ponte, S., *Bans, tests, and alchemy: Food safety regulation and the Uganda fish export industry*. Agriculture and Human Values, 2007. 24(2):179-193.
20. Grace, D., *Food Safety in Low and Middle Income countries*. International Journal of Environmental Research and Public Health, 2015. 12(9):10490-10507.
21. Per Pinstrup-Andersen, *The food system and its interaction with human health and nutrition*. 2020 Conference Brief 2011, No.13. Washington, D.C.:IFPRI.
22. Egorov, A.I. et al., *The effect of Helicobacter pylori infection on growth velocity in young children from poor urban communities in Ecuador*. International Journal of Infectious Diseases,2010. 14(9):788-791.
23. Calder, P.C. and Jackson, A.A. *Undernutrition, infection and immune function*. Nutrition Research Reviews, 2000. 13:3-29.
24. Cunningham-Rundles, S. et al. *Mechanisms of nutrient modulation of the immune response*. The Journal of Allergy and Clinical Microbiology, 2005. 115(6): 1119-1128.
25. Smith, L.E. et al. *Food chain mycotoxin exposure, gut health, and impaired growth: A conceptual framework*. Advances in Nutrition, 2012. 3:526-531.
26. Gregor, M.F. and Hotamisligil, G.S., *Inflammatory Mechanisms in Obesity*. Annual Review of Immunology, 2011. 29: 415-445.
27. Groop, L.C., et al., *Effect of insulin on oxidative and nonoxidative pathways of free fatty acid metabolism in human obesity*. American Journal of Physiology- Endocrinology and Metabolism, 1992. (263) 1.
28. Yudkin, J.S., *Inflammation, obesity, and the metabolic syndrome*. Hormone and Metabolic Research,2007. 39(10): 707-709.
29. Azziz-Baumgartner, E., et al., *Case–Control Study of an Acute Aflatoxicosis Outbreak, Kenya, 2004*. Environmental Health Perspectives, 2005. 113(12): 1779-1783.
30. Lewis, L., et al., *Aflatoxin contamination of commercial maize products during an outbreak of acute aflatoxicosis in Eastern and Central Kenya*. Environmental Health Perspectives, 2005. 113: 1763-1767.
31. Wagacha, J.M. and Muthomi,J.W., *Mycotoxin problem in Africa: Current status, implications to food safety and health and possible management strategies*. International Journal of Food Microbiology, 2008. 124: 1-12.
32. Grace, D., et al., *International agricultural research to reduce food risks: case studies on aflatoxins*. Food Security, 2015. 7: 569-582.
33. Grace, D. and McDermott, J., Food Safety: Reducing and Managing Scares. In 2014–2015 *Global Food Policy Report*; International Food Policy Research Institute: Washington D.C., USA, 2015.
34. AgHealth. *CGIAR scientists develop working groups to coordinate mycotoxin research*. [cited 05 March 2016]. Available at <https://aghealth.wordpress.com/2013/11/15/cigar-scientists-develop-working-groups-to-coordinate-mycotoxin-research/>
35. PACA. What is the aflatoxin problem? [cited 05 March 2014]. Available at www.aflatoxinpartnership.org
36. USAID and Danya International Inc., *Aflatoxin: A synthesis of the research in health, agriculture and trade*. 2012. [cited 05 March 2016]. Available at https://www.danya.com/portfolio/aflatoxin_report.pdf.
37. FAO and WHO, *Food Safety: A right or a privilege- Understanding the importance of food safety to the food security and nutrition agenda*. Second International Conference on Nutrition (ICN2) Food Safety Side Event 2014.
38. Grace, D., et al., *Safe Food, Fair Food: Participatory Risk Analysis for improving the safety of informally produced and marketed food in sub Saharan Africa*. Revue Africaine de Santé et de Productions Animales (RASPA). 2010. 8(S):3-11.
39. Otsuki, T., et al., *Saving Two in a Billion: Quantifying the Trade Effect of European Food Safety Standards on African Exports*. Food Policy, 2001a. 26 (5): 495–514.
40. Otsuki, T., et al., *What Price Precaution? European Harmonization of Aflatoxins Regulations and African Groundnut Exports*. European Review of Agricultural Economic, 2001b. 28 (3): 263–284.
41. Waliyar, et al., *Prevalence and distribution of aflatoxin contamination in groundnut (Arachis hypogaea L.) in Mali, West Africa*. Crop Protection, 2015. 70(1-7).
42. Matumba, L., et al., *Concentrating aflatoxins on the domestic markets through groundnut export: A focus on Malawian groundnut value and supply chain*. Food Control, 2015. 51(236-239).
43. Pazderka, C. and Emmott, A., *Chatham House Procurement for Development Forum: Groundnuts Case Study*. 2010. [cited 29 February 2016]. Available at www.chathamhouse.org
44. Kareem, F.O. et al. The implication of European Union's food regulations on developing countries: Food safety standards, entry price system and Africa's export. Global Food Discussion Paper 2015. No. 61.
45. WHO, *Safe and nutritious food is a prerequisite for health*. [cited 13 January 2016]. Available at http://www.euro.who.int/_data/assets/pdf_file/0018/140661/CorpBrochure_Nutritious_food.pdf.
46. Steele, M. and Odumeru, J., *Irrigation water as source of foodborne pathogens on fruit and vegetables*. Journal of Food Protection, 2004. 67(12):2839-2849.
47. Drechsel, P and Keraita, B., *Irrigated urban vegetable production in Ghana: Characteristics, Benefits and Risk Mitigation*: 2nd ed. Colombo, Sri Lanka: International Water Management Institute (IWMI). 2014:247.
48. Packepsky, Y. et al., *Irrigation waters as a source of pathogenic microorganisms in produce: A review*. In Sparks, D.L (editor). Advances in Agronomy, 113:73-138. Burlington Academic Press, 2011.
49. Ensink, J. et al., *Wastewater-irrigated vegetables: market handling versus irrigation water quality*. Tropical Medicine and International Health 2007. 12(S2):2-7.
50. Antwi-Agyei P et al., A Farm to Fork Risk Assessment for the Use of Wastewater in Agriculture in Accra, Ghana. PLoS ONE 2015. 10(11): e0142346.
51. Neff, R.A. et al., *A comparative study of allowable pesticide residue levels on produce in the United States*. Globalization and Health 2012. 8:2.
52. Waddington, H., and White, H.. *Farmer field schools: from agricultural extension to adult education*, 3ie Systematic Review Summary 1. 2014 London: International Initiative for Impact Evaluation (3ie).
53. Wilton Park., *Antimicrobial resistance in humans and animals in low and middle income countries: How can knowledge and action be strengthened at national level?* Report. WP1399. [cited 06 March 2016]. Available at <https://www.wiltonpark.org.uk/conference/wp1399/>
54. Grace, D. *Review of evidence on antimicrobial resistance and animal agriculture in developing countries*. 2015 UK: Evidence on Demand.
55. ILRI. *Safe and fair food for informal markets: A food safety impact narrative*. 2014 ILRI Research Brief 25. Nairobi, Kenya: ILRI.
56. Blackmore, E. et al., *Legitimising informal markets: a case study of the dairy sector in Kenya*. 2015 IIED Briefing Paper.
57. WHO., *Making street food safe in Viet Nam*. [cited 08 March 2016]. Available at <http://www.who.int/features/2015/food-safety-interview/en/>
58. Cunningham, K., *Connecting the milk grid: smallholder dairy in India*. In D.J. Spielman & R. Pandya-Lorch, eds Millions fed: proven successes in agriculture development, p. 117–124. 2009. Washington, DC, International Food Policy Research Institute.
59. Jabbar, M.A., Baker, D. and Fadiga, M.L. (eds). *Demand for livestock products in developing countries with a focus on quality and safety attributes: Evidence from Asia and Africa*. ILRI Research Report 24. 2010. Nairobi, Kenya, ILRI.
60. London School of Hygiene and Tropical Medicine. *Domestic and Food Hygiene*. [cited 05 March 2016].Available at <http://ehg.lshtm.ac.uk/food-hygiene>
61. Kadiyala, S. et al., *Using a Community-Led Video Approach to Promote Maternal, Infant, and Young Child Nutrition in Odisha, India: Results from a Pilot and Feasibility Study*. 2014. Arlington, VA: USAID/ Strengthening Partnerships, Results, and Innovations in Nutrition Globally (SPRING) Project.
62. Nesbitt et al., *Baseline for consumer food safety knowledge and behaviour in Canada*. Food Control, 2014. 38:157-173.
63. Gong, Y., et al., *Postweaning Exposure to Aflatoxin Results in Impaired Child Growth: A Longitudinal Study in Benin, West Africa*. Environmental Health Perspectives, 2004. 112(13):1334-1338.
64. Government of Timor-Leste. *Timor-Leste Food and Nutrition Survey 2013. Final Report* 2015. [cited 14 December]. Available at <http://www.nutritioninnovationlab.org/publication/timor-leste-food-and-nutrition-survey-2013-final-report/>
65. FAO. Family Nutrition Guide. Topic 7 Feeding young children aged over 6 months. 2004. FAO: Rome.
66. Democratic Republic of Timor-Leste., *Timor-Leste Food and Nutrition Survey*, Ministry of Health. 2013. Final Report 2015. Dili.
67. Langiano et al., *Food safety at home: knowledge and practices of consumers*. Journal of Public Health, 2012. 20:47-57.
68. Williamson, S., *Pesticide provision in liberalised Africa: Out of control?.* ODI AgREN, Network Paper 2003 No. 126.

How can Agriculture and Food System Policies improve Nutrition?




The multiple burdens on health created today for low- and middle-income countries by food-related nutrition problems include not only persistent undernutrition and stunting, but also widespread vitamin and mineral deficiencies and growing prevalence of overweight, obesity and non-communicable diseases. These different forms of malnutrition limit people's opportunity to live healthy and productive lives, and impede the growth of economies and whole societies.

The food environment from which consumers should be able to create healthy diets is influenced by four domains of economic activity:



In each of these domains, there is a range of policies that can have enormous influence on nutritional outcomes. In the Global Panel's Technical Brief, we explain how these policies can influence nutrition, both positively and negatively. We make an argument for an integrated approach, drawing on policies from across these domains, and the need for more empirical evidence to identify successful approaches.

Find out more here: <http://glopan.org/food-safety>



Assuring safe food systems provides policy options within the agricultural production, market and trade systems and food transformation and consumer demand domains to protect the safety and quality of consumers' diets.

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