

## FOOD SAFETY IN KENYA: STATUS, CHALLENGES, AND PROPOSED SOLUTIONS

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**F**oodborne disease—that is, disease caused by consuming foods contaminated with biological or chemical hazards—is an important and often underrecognized public health concern in low- and middle-income countries around the world, including Kenya. While comprehensive national statistics on the foodborne disease burden are not available, the best available evidence from the region indicates that diseases transmitted via contaminated food have a greater impact on public health in Africa than either tuberculosis or diabetes (Havelaar et al. 2015; GBDCN 2016). Beyond its contribution to illness and death, foodborne disease also plays a role in child stunting, which remains a persistent problem in Kenya, affecting 16 percent of children (KNBS and ICF 2023). One study based on 20 years of data from 5 countries attributed 25 percent of stunting to repeated diarrheal episodes (Checkley et al. 2008), many of which can be traced to microbial contamination of food.

Kenya's food system is in the midst of various transitions, which imply both new challenges and opportunities to ensure the safety of the food supply. First, we are seeing a shift away from the dominance of starchy staples in diets, and toward more fruits, vegetables, animal-source foods, and ready-to-eat foods. Second, the scale at which food is produced, processed, and distributed is increasing, and the distances over which it is transported to rapidly urbanizing population centers are growing. As observed by Jaffee and colleagues (2018), both of these trends increase the probability that food is contaminated with microbial hazards. Further, the intensification of food production may lead to increased use of potentially hazardous chemicals such as pesticides and antibiotics. On the other hand, the growing importance of larger-scale food production and processing firms could enable better food safety monitoring and regulatory enforcement in some food value chains.

While the market share of larger-scale processors is growing, small-scale, often informal, food businesses remain critical to Kenya's food supply and the food security of low-income populations (Owuor 2020). Application of traditional punitive regulatory enforcement approaches to this more fragmented sector presents enormous challenges, risks harming livelihoods and limiting food access, and fails to address the underlying problem of low compliance capacity. Developing context-appropriate systems through which the food that Kenya's multitude of farmers, butchers, milk traders, and roadside fruit and vegetable vendors grow, process, and sell can be made safer is critical to reducing the foodborne disease burden its population shoulders.

This chapter reviews recent evidence on the major food safety risks affecting Kenya and discusses strategies for addressing these. We begin by introducing the major categories of foodborne hazards and discussing evidence from Kenya on the prevalence and sources of these hazards in the key affected value chains. We then describe the current regulatory structure and challenges to effective governance. Finally, we identify opportunities for public action to reduce Kenya's foodborne disease burden, including through engagement of the small-scale, informal businesses that dominate Kenya's food supply but to which standard regulatory tools are ill-suited. We close the chapter with a summary of recommendations.

## **Food safety problems and affected value chains in Kenya**

### **Microbiological hazards**

Microbiological hazards, which include diarrheal and other disease agents as well as parasitic organisms, are by far the most important type of food safety hazard in terms of health impact, both at the global level and within Africa (Havelaar et al. 2015; GBD 2016). Perishable foods, including animal-source foods and fresh fruits and vegetables, are most prone to microbiological contamination.

Since most microorganisms are inactivated by heat treatment, contamination of perishable foods consumed raw (for example, fruits and salads) constitutes the greatest risk to health. However, even cooked foods may not be heated to a sufficient temperature, or for a sufficient time, to render all pathogens harmless. Also, certain microorganisms, such as *Staphylococcus aureus*, produce toxins that resist heat treatment. Moreover, microbes present on these foods may be

transferred to previously cooked foods, or to those eaten raw, during handling (Knechtges 2011).

Many organisms carried in the feces of livestock (for example, *Salmonella* spp, *Campylobacter* spp, and shiga toxin producing *E. coli*), are important foodborne pathogens. These pathogens may lead to on-farm contamination of animal products—milk and meat—as well as crops via contaminated irrigation water or manure applied as fertilizer, if this is not well composted (Jiang, Chen, and Dharmasena 2015). We next turn to the evidence regarding microbial contamination in vegetable, meat, and milk value chains.

### VEGETABLES

Water used to irrigate vegetables on small-scale commercial farms near Nairobi and Machakos has been shown to exceed allowable standards for microbial contamination by several orders of magnitude (Kitulu et al. 2020; Kutto et al. 2011). Despite the illegality of using wastewater for irrigation in Kenya, this practice is common in and near urban centers as a result of water scarcity (Kaluli et al. 2011). Water used to wash vegetables in informal wet markets around Nairobi has been found to be similarly contaminated with high levels of bacteria, including *Salmonella* (Kutto et al. 2011). Many roadside vendors offer shredded kale and cabbage; cutting the vegetables in this way provides bacteria with additional surfaces on which to grow.

Personal hygiene of food handlers is an important determinant of microbiological food safety throughout the value chain for any food product, in particular perishables such as fruits, vegetables, and animal-source foods. While Kenyan Standard 1758-II (Sections 13.1.6A, 13.12.5A, and 13.13.3) requires that all food business operators, from farm to retail, have a clean on-site toilet and handwashing facilities, a study of the tomato value chain in Laikipia found that in practice these were often absent (Gatere et al. 2020).

### MEAT

The safety of animal-source foods likewise begins on the farm. A study of small-scale poultry producers (defined as those with a minimum of 2 and a maximum of 800 birds) in Dagoretti and Kibera detected the pathogen *Campylobacter* in 33–44 percent of indigenous and broiler chicken farms in these two communities. This pathogen is one of the most frequently isolated from children suffering from diarrhea in Kenya (Carron et al. 2018). Unrestricted access to the flock (allowed at 88 percent of these farms) was associated with a higher likelihood of *Campylobacter* detection, while disinfection of enclosures (practiced by only 15 percent of farmers) reduced this risk.

Slaughter of animals is a particularly high-risk node for pathogen contamination of meat, primarily because of contact of meat with pathogens present in the digestive tract and feces of animals. Poor hygiene of personnel and the environment in abattoirs also facilitates the spread of pathogens between carcasses, amplifying the problem (Wambui et al. 2017). Data collected in 2012 by CGIAR researchers revealed that only 60 percent of slaughter facilities in western Kenya had a toilet, and 20 percent had handwashing facilities (Cook et al. 2017).

Food hygiene and temperature control practices are critical to meat safety beyond the slaughterhouse. Practices associated with *Campylobacter* contamination at small-scale chicken retailers in Nairobi included display of meat on a difficult-to-clean surface such as wood or cardboard, and selling defrosted meat (Carron et al. 2018).

#### MILK

Smallholder dairy farmers in Kenya often have low levels of knowledge about hygiene and biosecurity (Nyokabi et al. 2021a). Common practices among these producers, including unrestricted access to livestock, insufficient cleaning of enclosures, and unsanitary handling practices, lead to high levels of microbial contamination in milk (Nyokabi et al. 2021b).

A recent paper showed that, of all the foods consumed by infants in low-income neighborhoods of Kisumu, milk was the most likely to contain a pathogen (Tsai et al. 2019). This finding confirms analysis of nationally representative household data showing that children under 24 months who had consumed milk or fresh fruit were more likely to have suffered an episode of diarrhea within the previous two weeks, compared with those who had been exclusively breastfed (Hoffmann and Baral 2019). As these foods have high nutritional value for young children, it is critical that they are also safe, so that their benefits for child health can be fully harnessed and potential harms are minimized.

A study of infant food safety conducted among households in low-income neighborhoods of Kisumu found that over 90 percent of caregivers used ultra-high temperature (UHT) treated milk to feed their infants (Hoffmann et al. 2022). As contamination of UHT milk was low at point of purchase, most microbial contamination observed in infant food was introduced via household handling. However, contamination present at purchase also contributed to infants' exposure to diarrheal pathogens. This was especially true for milk that had been purchased raw, in which the rate of contamination with pathogens was high: 14 of 34 raw milk samples analyzed contained the pathogen *Salmonella enterica*, and 20 of 34 tested positive for *Shigella sonnei*. The same bacterial

species present in a typical sample of raw milk at purchase were detected in 33 percent of infant food samples prepared with that milk, indicating that milk heating practices were not sufficient to eliminate microbiological risk.

While formally packaged milk was far less likely to contain pathogens—2.2 percent of UHT pasteurized milk samples and 4.8 percent of conventionally pasteurized samples contained either *S. enterica* or *S. sonnei*—the probability of detecting the same organism in both these milk types at purchase and in the linked infant food sample was far higher (65 percent for UHT milk). This suggests that caregiver handling practices may differ by milk type, and raises the concern that, as food systems modernize, consumer expectations regarding the safety of food may shift, leading them to rely more on pre-market controls.

## **Chemical hazards**

### **HEAVY METALS**

Heavy metals, which can increase cancer risk and lead to lifelong cognitive impairment, are the most important class of chemical foodborne hazards, in terms of disability-adjusted life years lost (Havelaar et al. 2015; Gibb et al. 2019). Heavy metals may enter the environment through industrial effluent, disposal of household waste, disintegration of lead-based paint, and current or previous use of pesticides or fertilizer containing heavy metals in growing sites (ATSDR 2012; NASEM 2017). They then enter crops through irrigation water and agricultural soils (Makokha et al. 2008; Inoti et al. 2012). While regulations exist in Kenya limiting the use of lead (for example, in paint), there are concerns with compliance and enforcement (WHO 2018). A 2017 study found that 71 percent of paints sold in Kenya exceeded this standard, with 50 percent over 7 times above the limit, and 1 almost 18,000 times over the limit (CEJAD and IPEN 2017).

While systematic data are lacking, the available evidence suggests that heavy metal contamination of vegetables in Kenya could be significant. For example, a CGIAR study of contamination in tomatoes grown in Laikipia county, in an area not known for high levels of pollution, found that 52 percent of samples exceeded the World Health Organization (WHO) standard for lead, and 24 percent exceeded that for cadmium (Gatere et al. 2020). This is notable as the rate of uptake of heavy metals into tomato fruit is relatively low, and the sites from which samples were taken were not known to be high in risk. Other studies that have sampled crops from areas known to be heavily polluted have found average levels of heavy metals up to 125 times over the WHO standard (Makokha et al. 2008; Karanja et al. 2010; Gallaher et al. 2013).

## AFLATOXIN

Kenya is a global hotspot for aflatoxin, a fungal toxin (mycotoxin) that is highly carcinogenic and associated with child stunting (Liu et al. 2012; Ismail et al. 2021). Aflatoxin contamination arises in crops, especially maize and groundnuts, as a result of the presence of molds that occur naturally in soils, and is exacerbated by poor postharvest practices.

Fatal outbreaks of aflatoxin poisoning resulting from consumption of highly contaminated maize caused an average of nine deaths per year in Kenya during the period from 1981 to 2014, and over twice this rate from 2001 to 2014 (Hoffmann and Jones 2021, Table D1). In recent years, government food safety surveillance efforts, media attention, and international funding for both food safety research and capacity building in Kenya have been focused on this hazard (Mutua, Grace, and Watts 2021). While aflatoxin represents a relatively minor portion of the total regional food safety burden as quantified by WHO (Havelaar et al. 2015),<sup>1</sup> much of the research on firm and consumer responses to food safety risk in Kenya relates to aflatoxin.

Heavy reliance on maize, combined with low dietary diversity among low-income segments of the population, implies high levels of aflatoxin exposure among Kenyans (Leroy, Wang, and Jones 2015; Mutege, Cotty, and Bandyopadhyay 2018). Indeed, a comparison of blood aflatoxin levels across six African countries showed that levels in Kenya during an outbreak year were an order of magnitude higher than those observed in any other country (Xu, Gong, and Routledge 2018). As the potential harms resulting from aflatoxin, in particular its suspected effect on children's development, are not fully understood, a cautious approach to control of this hazard is warranted.

However, if we consider only the health consequences of aflatoxin exposure for which the scientific case is clear (that is, deaths as a result of cancer and acute aflatoxin poisoning), the impact of this contaminant is dwarfed by those of other, primarily biological, foodborne hazards. CGIAR researchers estimated, based on observed aflatoxin levels in food during a typical year, that the resulting level of exposure would lead to 67 liver cancer deaths annually in eastern Kenya, the region with the highest aflatoxin levels in crops and also the highest human exposure based on blood analysis (Hoffmann and Jones

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1 The WHO calculations do not include the potential impact of aflatoxin on child growth or immune function, as the authors did not consider these sufficiently well established. A randomized controlled trial by CGIAR researchers testing the impact of removing aflatoxin from children's diets in eastern Kenya showed ambiguous results, with an impact on child growth detected at 11–19 months after enrollment but not on the primary study outcome of growth at 24 months (Hoffmann, Jones, and Leroy 2018).

2021).<sup>2</sup> Scaling the cancer risk resulting from aflatoxin exposure using regionally representative data from the analysis of blood samples (Yard et al. 2013), and combining this with reported cases of fatal aflatoxin poisoning, the total number of deaths owing to this toxin nationally can be estimated at 155 per year, 146 from cancer and 9 from aflatoxicosis. To put this in context, the estimated number of child deaths as a result of foodborne diarrheal disease in Kenya is 8.5 times greater, at approximately 1,328 annually (Hoffmann and Baral 2020), than the number of deaths due to aflatoxin.

### PESTICIDES

Most of the available data on pesticide contamination are based on crops destined for export and thus of limited use for estimating risk in the domestic food supply. One study found that none of 61 samples of tomatoes grown in Laikipia in 2019 for the local market were found by the Kenya Plant Health Inspectorate Service to contain pesticides above levels allowed under EU law (Gatere et al. 2020). Negative health effects of pesticide exposure have, however, been documented among Kenyan vegetable farm workers (Macharia 2015).

## **Challenges and potential solutions to improve food safety in Kenya**

Kenya faces some of the same challenges to the effective control of food safety risks as governments all over the world, including regulatory fragmentation across line ministries and levels of government, and limited public resources. In addition, inappropriate regulatory standards and a large informal food sector are challenges that are common to Kenya and other low- and middle-income countries.

### **Regulatory fragmentation**

Food safety governance in Kenya is highly fragmented, across levels of government (national versus county), commodities (horticulture, dairy, meat, fish, grains), and locations (environment, farm, factory, retail). Food safety policies and laws are generally enacted at the national level with participation of county governments but responsibility for enforcing laws and standards often falls to counties.

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2 Reported levels of aflatoxin in maize grown in eastern Kenya regularly include observations in the thousands of parts per billion, while maximum values in other parts of the country tend to be in the hundreds of parts per billion. The regulatory limit for aflatoxin in Kenya is 10 parts per billion (Mutegi, Cotty, and Bandyopadhyay 2018).

Harmonization of food safety governance across these levels of government is achieved through alignment of county policies and laws with those adopted at the national level. For example, following the Kenya National Nutrition Action Plan, the Murang'a County Nutrition Action Plan includes several food safety-specific actions (Murang'a, Department of Health Services 2020). However, during the years covered by the Murang'a Plan (2020/21–2024/25), none of these activities were allocated any budget. Budget constraints have generally been the bottleneck in implementing county functions across sectors, as services are devolved but the funds transferred by the national government are insufficient to implement them. Analysis conducted by CGIAR researchers based on budget tracking for Murang'a, Laikipia, Nakuru, Nyandarua, and Nairobi counties found that public spending on food safety at both the national and the county level was low compared with the estimated cost of foodborne illness (Hoffmann and Baral 2019; Guthiga, Kirui, and Karugia 2020).

Beyond the challenges of implementing policies in a devolved governance structure, multiple line ministries and other public agencies share responsibility for food safety. Taking as an example the value chain for maize flour, the Ministry of Agriculture, Livestock, Fisheries, and Cooperatives has jurisdiction over practices applied on farm, while the crop is grown and stored prior to sale. The Agriculture and Food Authority manages the system, allowing traceability from the miller back to the farm. The Kenya Bureau of Standards is responsible for the inspection and registration of the maize flour brand. And finally, the Ministry of Health monitors safety of this product once it is available for purchase. While the National Food Safety Coordinating Committee constitutes an important channel for communication across these bodies, the demarcation of specific responsibilities is often unclear, leading to overlap of mandates and wastage of resources. It is not uncommon to find several different agencies inspecting the same factory at different times.

This patchwork of jurisdictions is not unique to Kenya. The multisectoral nature of this issue means that many countries have food safety responsibilities spread across disparate government agencies, a fact that has often been criticized as leading to inefficiencies and system failures (Heinzerling 2015). Other member states of the East African Community have created food and drug authorities but these have not always reduced overlaps and wastage as hoped, as the mandates of existing agencies involved in food safety have never been adjusted (Kang'ethe et al. 2021). Tanzania is a case in point: the functions of the Tanzanian Food and Drug Authority overlapped with those of the Tanzanian Bureau of Standards, leading to the former's disbandment and the redistribution of functions after several years. Kenya should take this as a cautionary tale

when implementing any institutional solution to integrate food safety activities across agencies.

### **Inappropriate regulatory standards**

Like many low- and middle-income countries, Kenya has to a large extent adopted food safety standards developed by high-income countries and adopted by international bodies (Sirma et al. 2018). While harmonization with such standards is critical for gaining access to export markets, compliance may be infeasible in the context of inadequate water, sanitation, and cold chain infrastructure.

Significant rates of noncompliance with standards are observed in the formal and informal sectors alike, including in leafy greens (Kutto et al. 2011), milk (Wanjala et al. 2017), and maize flour (Hoffmann and Moser 2017; Hoffmann, Moser, and Herrman 2021). The development of locally appropriate standards, in line with Kenya's food safety priorities and current hazard prevalence, combined with investment in the food safety capacity of food business operators and the creation of incentives for compliance, may offer a way to progressively register and formalize informal businesses (Blackmore, Alonso, and Grace 2015).

Heavy-handed enforcement of standards should be avoided as this can lead to tragic unintended consequences. For example, forcible relocation of butchers to an upgraded but inconveniently located market led to riots and deaths in Nigeria (Grace, Dipeolu, and Alonso 2019). CGIAR authors have also noted that destruction of foodstuffs that exceed Kenya's aflatoxin standards would have a devastating impact on food security, far worse than the public health benefit to be gained by such enforcement (Sirma et al. 2018).

### **Importance of informal food markets**

Although informal markets are critical to the supply of animal-source foods and fruits and vegetables in Kenya, this sector is not adequately addressed in current food safety policies or practice (Kang'ethe et al. 2021). This means that much of the Kenyan food supply is outside the reach of public systems and private incentive structures that could be used to improve its safety. Unless effort is directed to addressing the food safety challenges of informal food markets that supply most animal-source foods, fruits, and vegetables to the majority of Kenyans, the foodborne disease burden will remain high.

Even in value chains where part of the food chain is formalized, typically from the point of processing, primary production is often still informal. This implies challenges to implementing the recommended farm-to-fork management approach of food safety. For example, the government regulates large-scale

maize processors. Some of these pay a significant premium for maize that meets food safety and other quality standards in order to ensure their compliance with food safety regulations (Hoffmann and Moser 2017). However, as traders typically do not have traceability systems in place, and procure grain from a large number of small-scale farmers, this premium does not flow back to farmers, whose actions are critical to aflatoxin control. The logistical complexity and cost of testing farmers' grain prior to purchase, as well as the option to sell maize found to be noncompliant on the informal bulk grain market, means traders have little incentive to impose quality requirements on farmers.

The coexistence of formal and informal food systems also poses regulatory challenges when the two operate in parallel. While more comprehensive surveillance and stringent application of standards in maize is likely to improve compliance within the formal sector, this would imply that a greater share of maize sold as whole grain, or processed by small-scale, informal hammer mills known locally as *posho* mills, would previously have been rejected by formal millers. Formally processed maize flour is already significantly less contaminated on average than the lower-cost flour processed by *posho* mills, which is primarily consumed by lower-income Kenyans (Kariuki and Hoffmann 2021). Stricter enforcement in the formal sector would be expected to widen this inequitable food safety gap. A more effective approach in this particular case would be to inform consumers of the relative safety of formally marketed grain.<sup>3</sup>

To address the more general challenge of improving food safety in the informal market, we propose a progressive regulatory approach that combines training food business operators on practices to improve food safety, offering voluntary certification based on observed food safety practices and/or outcomes, and building consumer awareness of and demand for food safety. Such an approach meets vendors where they are and encourages incremental improvements in practices rather than expecting immediate compliance with standards that are often infeasible in the context of limited access to water and cold chain infrastructure. Thailand's Clean Food Good Taste project, jointly implemented by Thailand's Department of Health, the Tourism Authority, and local governments through the Ministry of the Interior since 1989, is a successful example of a voluntary public food safety certification program (Kongchuntuk 2002).

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3 The lower aflatoxin contamination level in formally marketed maize flour appears to owe primarily to the fact that the milling process removes most of the germ and bran, where aflatoxin is concentrated. While this removes valuable fiber and nutrients, the mandated addition of micronutrient premix to formally marketed flour more than compensates for the loss of nutrients (though not fiber).

### **Limited public resources**

Kenya's food inspectorate service lacks the budget and capacity to fully address the country's food safety problems. In addition to increasing the public resources available for this purpose, the capacity of private firms to monitor their own food safety outcomes could be leveraged. Since the early 1990s, food safety regulation in high-income countries has moved away from relying on command-and-control policies toward increased involvement of regulated firms in determining how they will meet standards (Henson and Caswell 1999; Rouvière and Caswell 2012). This approach, variously referred to as "coregulation" or "enforced self-regulation," shifts responsibility for routine monitoring of food safety practices and outcomes to food businesses. An important distinction between coregulation and industry self-regulation is that the regulator provides oversight (for example, through duplicate testing of samples), and retains the right to sanction firms for noncompliance. The organization Aflatoxin Proficiency Testing and Control in Africa has worked with Kenyan maize milling firms and the Meru county government to promote a coregulatory approach to aflatoxin management.<sup>4</sup>

### **Interventions to improve food safety**

This section outlines recommendations for specific public actions to improve the safety of foods in Kenya's markets and reduce the foodborne disease burden. We discuss these in sequence from production to consumption, beginning with the control of environmental contaminants that may become foodborne.

#### **Enforce regulations regarding environmental pollutants**

Regulations that limit the use of lead and other harmful heavy metals in industrial and household products should be enforced, as these contaminants make their way into food supplies via contaminated irrigation water and soil. While the existing code of practice for production of fruits and vegetables, KS 1758-II, specifies that irrigation water should be tested annually, few farmers follow this guideline in practice (Gatere et al. 2020). Making information available on the microbiological and heavy metal contamination of water bodies, and on recommended mitigation strategies, would enable farmers to manage the risks these hazards pose. For example, crops with lower uptake of heavy metals could be grown in polluted areas, and preharvest watering intervals could be observed to reduce microbial contamination risk.

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<sup>4</sup> <https://apteca.tamu.edu/>

### **Build food safety capacity throughout value chains**

Research by CGIAR and others shows that, across a wide range of contexts, both food safety practices and hazard prevalence can be significantly improved by building the capacity of farmers and food handlers through the provision of training and tools.

In eastern Kenyan communities, where training and postharvest technologies including drying sheets, a mobile drying service, and hermetic storage bags were made available and partially subsidized, aflatoxin levels reduced by half (Pretari, Hoffmann, and Tian 2019).<sup>5</sup> In Ghana, training on postharvest handling recommendations for aflatoxin control led to significant improvements in farmers' practices. Effects were stronger when tools to implement recommended practices were also provided (Magnan et al. 2021). Farmers' food safety capacity can be built by including this topic within agricultural extension programs and rural development projects that aim to boost smallholder productivity and incomes. An example of this approach is the East African Dairy Development Project, which includes training on milking hygiene and its benefits.<sup>6</sup>

Improving firms' capacity for food safety testing can have impacts even among formal sector firms (Herrman et al. 2020). This can have significant effects on population health if the market share of these firms is large, as it is for large-scale maize processors in Kenya.

Building the capacity of small-scale, often informal, retailers is relatively costly per unit of food affected, but reaching these vendors is critical, as most Kenyan consumers rely on such firms for fresh produce, meat, and milk—the riskiest foods in terms of microbial contamination. CGIAR has pioneered the “three-legged stool” approach to improving food safety in informal markets, which relies on three pillars that underlie food safety interventions: capacity building of business operators, incentives to support behavior change, and promotion of an enabling policy environment (Alonso Alvarez, Grace, and Nguyen-Viet 2021). Several intervention studies based on this model have shown that significant improvements in food safety practices and outcomes can be achieved by providing food vendors with training and simple materials

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5 Many of the studies conducted in Kenya have focused on aflatoxin control, as detection of this contaminant is relatively easy and low in cost. High levels of public concern and regulatory attention to this hazard create the conditions for strong behavioral responses to information and the promotion of control technologies. This allows researchers to detect impacts of interventions on the responses of consumers and food business operators relatively easily. However, it is important to bear in mind that responses to similar interventions addressing other food safety hazards may vary.

6 [www.heifer.org/our-work/flagship-projects/east-africa-dairy-development-project.html](http://www.heifer.org/our-work/flagship-projects/east-africa-dairy-development-project.html)

or equipment, such as easy-to-clean cutting boards (Lindahl et al. 2018; Chea et al. 2021).

Two caveats are in order regarding the importance of capacity building. First, in the absence of access to appropriate infrastructure and equipment, training alone may be insufficient to change practices or improve food safety. This was the case for Kenyan abattoir workers, who failed to adopt the hygienic practices on which they were trained (Mwai 2011). Access to sufficient water and the means to heat it, as well as supplies such as disinfectants and soap, remained barriers. The fact that most workers were paid on a piece rate basis implied an incentive to work fast but not necessarily carefully (Mwai 2011). Second, as the effect of capacity building on food safety knowledge, practices, and outcomes can fade over time, repeated engagement with businesses is important to sustaining the impact of such interventions (Kinyua et al. 2021).

### **Support the development of incentives for safer food**

Incentives for food business operators and food handlers to invest in food safety are critical. Potential motivators for the adoption of better food safety practices include reduced risk of spoilage, higher prices or sales volumes, and avoidance of regulatory enforcement action or a negative consumer response should a food safety problem become known.

A study conducted in Meru and Tharaka-Nithi counties showed that maize growers producing solely for home consumption used better postharvest practices than did farmers who sold a portion of their maize. Providing incentive payments to farmers for maize that met aflatoxin standards narrowed this gap (Hoffmann and Jones 2021). A separate trial in the same region found that most farmers who had purchased the aflatoxin control product Aflasafe had done so to ensure the safety of their own food supply. Introducing a small market incentive for safe grain more than doubled the amount of the product purchased (Hoffmann et al. 2022).

While this evidence points to the potential for market incentives to improve practices, the fragmented nature of Kenyan value chains can make this difficult. Examples of value chains in which requirements for farm-to-fork food safety practices have been successfully implemented include the horticultural export sector and a handful of fruit and vegetable distributors supplying premium markets.<sup>7</sup>

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<sup>7</sup> An example of a fruit and vegetable distributor that monitors food safety is Instaveg (COLEAD 2021).

There may be opportunities to incentivize better hygiene practices in milk value chains through quality-based payment systems. Lower microbial load is an important quality criterion used by cooling plants and dairy processors as it both reduces spoilage and allows for value addition and processing into dairy products, while also implying better food safety. Premium payments based on quality parameters including hygiene have therefore been adopted by milk processors in Indonesia, Brazil, and India, and piloted in Kenya (Ndambi, Dido, and Gülzari 2020; Treurniet 2021). Even outside of formalized quality payment systems, qualitative research shows that milk vendors perceive economic benefits to employing hygienic practices, through lower spoilage, the ability to charge higher prices, and customer retention (Alonso et al. 2018).

Other incentives for participation in trainings and uptake of improved practices could include facilitation of a license to operate legally, improved business skills, and earning esteem within peer networks (Blackmore, Alonso, and Grace 2015).

### **Invest in water, sanitation, and hygiene infrastructure**

Public provision of water, sanitation, and hygiene (WASH) infrastructure and promotion of good hand and food hygiene practices at points through which large volumes of food pass could potentially be a cost-effective way to improve food safety. Such high-volume nodes include abattoirs, designated markets, and other areas where vendors congregate. Handwashing stations deployed to markets as part of the COVID-19 response are likely to reduce transmission of other infectious agents including foodborne diseases and should continue to be maintained.

While provision of modern infrastructure alone is not sufficient to address food safety challenges in informal markets (Grace, Dipeolu, and Alonso 2018), without access to adequate infrastructure even well-trained and motivated business operators will struggle to maintain appropriate food and hand hygiene. As informal businesses often have limited access to appropriate equipment, such as regulation-compliant food containers, cutting boards, or fridges, facilitating access to credit, especially among women, and making basic equipment available can allow food business operators to overcome financial constraints to food safety upgrading.

### **Build consumer demand**

Pairing training and certification programs with interventions to build consumer demand for safer food could increase their effectiveness by strengthening market incentives. A recent experimental study found that

communicating both risks and recommendations for less risky products had an impact on consumer food choices (Kariuki and Hoffmann 2021). Through this study, conducted in Meru town, some consumers were told which maize flour brands were most likely to comply with Kenya's aflatoxin regulation; others were given this information plus test results for the maize flour they were currently consuming. Nine weeks later, those given test results were more likely to be consuming one of the safer brands, whereas those given only the safer brands recommendation had not significantly changed their maize choices. The results were driven, unsurprisingly, by those whose maize had tested above the regulatory aflatoxin limit, indicating that change is much more likely for those made aware of a problem. While household-level testing for food safety hazards is not feasible, systematic surveillance of high-risk foods and provision of relative risk information by certification status, vendor, or product type could be used to steer consumers toward safer choices.

### **Educate caregivers of infants and young children on food hygiene practices**

As infants and young children face the greatest health risk from foodborne infectious disease, improving household handling of foods consumed by this group is critical. Despite the higher levels of contamination found in food relative to water (Lanata 2003; Kung'u et al. 2009), food safety has been a relatively neglected aspect of infant and young child health and feeding programming globally. High-quality evidence shows that training caregivers of young children on safe food handling practices can improve practices and reduce microbial contamination (Islam et al. 2013; Touré et al. 2013; Gautam et al. 2017).

A study involving over 4,000 infants living in informal settlements within Nairobi found that only 2 percent were exclusively breastfed up to six months, and the mean age at which complementary foods were introduced was one month (Kimani-Murage 2011). Information on safe handling of infant food should thus be provided as part of standard postnatal care and support, while promotion of the WHO recommendation of exclusive breastfeeding up to six months should be continued.

### **Summary of recommendations**

**Conduct monitoring of water sources used for irrigation, and remediate problems.** Compliance with the requirement for testing of irrigation water under the horticultural code of practice for fruits and vegetables is low. Public testing of commonly used water bodies could be used to identify where

agricultural practices should be adapted to mitigate risks and inform efforts to address pollution sources.

**Provide WASH infrastructure at markets and abattoirs.** Informal food markets and processing facilities often lack adequate infrastructure for WASH. Access to safe water, toilets, and handwashing facilities is a prerequisite for food handlers to maintain appropriate hand and food hygiene, and public provision of these necessities is likely to be a cost-effective way to reduce foodborne disease.

**Build capacity and incentivize food safety among small-scale, informal businesses.** Small-scale businesses, from farm to fork, are critical to Kenya's food supply but often lack the capacity to adhere to food safety standards. Improving the capacity of food business operators, especially in the area of hand and food hygiene, and creating mechanisms to incentivize improvements in food safety can lead to meaningful gains in public health. In this context, rewarding improved food safety performance is likely to be more effective than enforcing compliance with standards that may not be attainable.

**Implement regular and comprehensive surveillance of high-risk foods.** Surveillance of high-risk foods should include collection and analysis of a representative set of samples, including from small-scale, informal businesses. Information on the relative hazard rates observed across food and business types could be used to steer consumers toward safer choices.

**Leverage private sector capacity for self-monitoring under a coregulatory approach.** Regular and representative food safety inspections require significant resources. Putting responsibility for routine monitoring of food safety compliance in the hands of businesses, with oversight provided by the regulator, can stretch budgets further and increase the efficiency of food safety surveillance.

**Include food safety in infant and young child feeding recommendations for caregivers.** Information on child health and nutrition given to caregivers of infants and young children through perinatal and child health clinics and via community health volunteers should include recommendations on food hygiene and heat treatment, while continuing to promote exclusive breastfeeding up to six months of age.

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