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FEED THE FUTURE INNOVATION LAB FOR FOOD SAFETY (FSIL)

Food Safety Investments in East Africa

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Food Safety Investments in East Africa

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Acronyms

Abbreviation	Description
AfDB	African Development Bank
AflaSTOP	Storage and Drying for Aflatoxin Prevention Project
AFR	Africa
AMR	antimicrobial resistance
ASF	animal source foods
ATTC	Aflasafe Technology Transfer and Commercialization initiative
CAC	Codex Alimentarius Commission
CGIAR	Formerly, this acronym stood for the Consultative Group for International Agricultural Research. It is now considered a word and not an acronym.
COMESA	Common Market for Eastern and Southern Africa
DALY	disability-adjusted life year
DFID	Department for International Development (replaced by the Foreign, Commonwealth & Development Office)
DTRA	Defense Threat Reduction Agency
EAC	East African Community
EC	European Community
FAO	Food and Agriculture Organization of the United Nations
FBD	foodborne diseases
FERG	Foodborne Disease Burden Epidemiology Reference Group
GAFSP	Global Agriculture and Food Security Program
GFSP	Global Food Safety Partnership
HAZEL	Hazards Associated with Zoonotic enteric pathogens in Emerging Livestock meat pathways
IITA	International Institute of Tropical Agriculture
ILRI	International Livestock Research Institute
LMIC	low- and middle-income countries
NACAP	National Aflatoxin Control Action Plan
NGO	non-governmental organization
PACA	Partnership for Aflatoxin Control in Africa
SMEs	small and medium-sized enterprises
SPS	sanitary and phytosanitary
SSA	sub-Saharan Africa

STDF	Standards and Trade Development Facility
TANIPAC	Tanzania Initiative for Preventing Aflatoxin Contamination
USAID	United States Agency for International Development
USD	United States Dollars
USDA	United States Department of Agriculture
WHO	World Health Organization
WTO	World Trade Organization

Executive Summary

Foodborne diseases are a threat to public health. They also impose an enormous economic burden, affect food and nutrition security, and can hinder market access and disrupt livelihoods. In 2017–2018, the Global Food Safety Partnership (GFSP), a public-private initiative hosted by the World Bank, undertook an intensive analysis of recent food safety investments in sub-Saharan Africa. GFSP built a database of projects and interviewed key informants. We reviewed the food safety investment database, and data related to countries in East Africa was extracted.

Fifty-nine projects from 19 donors were analyzed. Project numbers and investments trended up over time, and three to four countries in the region attracted significantly more investment. Most of the projects ran for three to four years. Aflatoxin mitigation and national control systems predominated over other projects. Fifteen projects included consumer education on food safety. Food safety of fresh produce was not a major food safety focus in any of the countries. Animal source foods (ASF) such as meat, fish, and dairy, as well as microbiological hazards, were addressed in all countries except Burundi and South Sudan. Some projects addressed pesticides but not the microbiological hazards that are a major concern in East Africa, as elsewhere. Similarly, the lack of investment in *Taenia solium* (pork tapeworm) is notable given the burden of cysticercosis in the region.

We also extracted information from 30 key informant interviews held with food safety experts with experience working in East Africa. These confirmed the investment emphasis on exports and strengthening national control systems to support exports. They considered this emphasis relatively successful in supporting exports but noted it had little benefit on the informal sectors that supply most food in East Africa. Their concerns were related to a lack of enforcement of regulations, lack of project follow-up, and failure to address informal markets. They considered gender important and recommended more focus on capacity building, empowering the private sector, raising awareness, and improving governance.

Findings from this study highlight regional investment needs and can be used to lobby for increased donor support, even at the country level. In addition, the GFSP study collected information and opinions from key informant interviews with experts in East Africa. We updated this with information from the authors.

Combined recommendations from review of these two sources include:

- Need for greater emphasis on hazards that cause the most domestic health burden (especially microbial hazards)
- Continued development of disease surveillance systems

- Greater investment in policies that are pro-poor and avoid unintended consequences
- Longer-term projects and better evaluation
- Streamlining and better implementation of regulations
- More involvement of the private sector in improving food safety
- Investigating the potential of harnessing consumer demand for food safety to better ensure sustainability
- Risk assessment is needed to allow for prioritization of needs and ensure available resources are put to appropriate use

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1.0 Introduction

This report describes previous investments in food safety in East Africa in order to guide future investments. It draws largely from the first comprehensive study on food safety investments in sub-Saharan Africa (SSA) conducted by the Global Food Safety Partnership (GFSP). This information is supplemented by additional literature review and the authors' experience researching food safety in the region. It is an output of the Feed the Future Innovation Laboratory for Food Safety led by Purdue University and Cornell University.

Foodborne diseases (FBD) are a threat to public health. They affect food security and can hinder market access and disrupt livelihoods. It is now clear that preventable FBD contributes significantly to the health burden. In 2010, the first global study of FBD assessed 31 foodborne hazards. It estimated these caused 600 million illnesses worldwide and resulted in 420,000 deaths in 2010 (Havelaar et al., 2015). Another part of the study assessed the burden of four foodborne metal toxins: These caused an additional one million illnesses and 56,000 deaths in 2015 (Gibb et al., 2019). The World Health Organization–Foodborne Disease Burden Epidemiology Reference Group (WHO-FERG) study found the burden to be particularly high in Africa and Asia (WHO, 2015).

The burden data were presented by WHO sub-regions (defined based on child and adult mortality). In the AFR E grouping, which encompasses 20 countries in Eastern and Southern Africa, 1,200 disability-adjusted life years (DALYs) per 100,000 population were attributed to the first 31 hazards. Hazards responsible for the largest share of the burden include bacterial disease agents such as non-typhoidal *Salmonella enterica,* enteropathogenic *Escherichia coli,* enterotoxigenic *E. coli, Vibrio cholerae,* and the pork tapeworm *Taenia solium.* The four foodborne metals assessed in the second part of the FERG study were responsible for 152 DALYs per 100,000 population, most due to lead (82 DALYs per 100,000).

Further, unsafe foods in low- and middle-income countries (LMICs) cost about 110 billion United States Dollars (USD) annually in lost productivity and medical treatment (Jaffee et al., 2019). While interventions with the potential to improve food safety exist, access in many countries is still limited. Where they do exist, the within-country distribution is not uniform. A strong and operational food control system across the food system is critical in assuring food safety at the national level; however, the fragmentation, governance, and funding constraints of existing regulatory agencies affect performance in East Africa. The Codex Alimentarius Commission (CAC) develops international standards on food safety, and countries are encouraged to use these to develop standards that are appropriate for their context. Most countries in East Africa have established standards, and the East African Commission (EAC) is

active in harmonizing standards for member states. Standards, however, are largely unimplemented and, when implemented, can have unintended consequences on food access and livelihoods. Food safety compliance and lack of financial incentives present additional challenges. Government certification is increasingly common but does not cover informal value chains, which comprise most of the marketed food in East Africa. Private certification programs, such as Global G.A.P., may be used by larger retailers for supplier verification but are not accessible to most food producers.

Foodborne diseases are still a major problem in SSA despite efforts by governments, nongovernmental organizations (NGOs), and donors to address them. Investments have successfully supported increases in safe exports, but it is important that investments target food that is sold through the informal domestic markets where most of the food produced in country is sourced for consumption (GFSP, 2019). The majority of consumers in SSA purchase their food through these markets, and failing to prioritize them in food safety interventions will leave a large population of consumers exposed to foodborne disease hazards. It is important to regulate in order to ensure compliance. At the same time, over-regulation is likely to lead to informal traders going underground, worsening the health challenge and limiting food access for consumers. The absence of financial incentives for food safety and the existence of a physical infrastructure that is not supportive of food safety (clean water, sanitation, and hygiene [WASH] services; safe storage; cold chain; lab capacity) are additional concerns. Creating greater demand for food safety through consumer education has the potential to change food systems, but an enabling environment must be provided in order to accomplish lasting change. Other incentives, such as social norms or better relations with food safety authorities, may also influence the behavior of value chain actors.

Best current evidence on the burden of FBD in East Africa

According to the first part of the FERG study, diarrheal diseases are responsible for 70% of FBD in the Africa (AFR) region, with the remainder attributed to helminths, invasive infectious disease agents, and chemicals/toxins. Non-typhoidal *Salmonella* (mostly due to contaminated eggs and poultry) causes the most deaths, killing 32,000 annually in the AFR region. Ten percent of this overall FBD burden in AFR is caused by *T. solium,* which receives relatively scant attention from donors. Source attribution studies point to ASF, along with fresh produce, as being especially risky food items. The median ASF burden in the African subregions AFR D and E was 580 (95% UI 314–879) and 459 (95% UI 294–625) DALYs per 100,000 population, respectively, a burden that is remarkably higher than those in the A subregions, including AMR A, WPR A, and EUR A (ranging between 21 and 25 DALYs per 100,000 population). Non-typhoidal *Salmonella* and *Campylobacter* are significant problems in poultry meat, but *Salmonella* can be found in any of the eight ASF. Shiga toxin-producing *E. coli* is primarily found

in beef, the meat from small ruminants, and dairy, as well as pork, vegetables, fruits, and nuts, whereas *T. solium* is found exclusively in pork.

The second part of the FERG study, focusing on four foodborne metals, used a different methodology, which limits the extent calculated estimates can be compared. Nonetheless, the results were at least approximately comparable. The heavy metal study found that foodborne lead was responsible for 61% of the burden, methylmercury for 29%, arsenic for 9%, and cadmium for less than 1%. All the burdens attributable to lead and methyl mercury were due to their effects on intellectual disability, whereas the impacts of arsenic caused bladder, lung, and skin cancer. The median burden in DALYs per 100,000 was slightly lower in WHO sub-region AFR E than AFR D, and both subregions were higher than AMR D and WPR B. In Africa, cookware is a common source of lead contamination of food, and lead may also enter food via drinking water systems with lead solders and pipes or through food itself when grown in lead-contaminated soils. Additionally, methylmercury contamination can arise from artisanal mining when miners use domestic cookware to refine gold using mercury. Mercury can also contaminate water, resulting in exposure through fish consumption.

Important recent food safety developments in Africa

1) "The Future of Food Safety," the first international conference on food safety in Africa, was held in Addis Ababa in early 2019. The workshop addressed the following topics: the burden of foodborne diseases and the benefits of investing in safe food; safe and sustainable food systems in an era of accelerated climate change; science, innovation, and digital transformation at the service of food safety; and empowering consumers to make healthy choices and support sustainable food systems (FAO, 2019).
2) The Africa Food Safety Index was developed in 2018–2019 and is being used in tracking food safety on the continent. This is in addition to 43 other indicators that the Comprehensive Africa Agriculture Development Programme (CAADP) monitors through its biennial process to assess progress toward meeting targets set under the Malabo Declaration of 2014. Among these indicators are halving poverty by 2025 and boosting intra-Africa trade. The index provides data on both burden and food safety system performance.
3) The EAC has a Food and Nutrition Security strategy that includes some aspects of food safety, including raising awareness, control of aflatoxins, documentation of food safety, and developing the capacity of small and medium-sized enterprises (SMEs) on food safety (EAC, 2018).
4) The donor landscape is also changing. The United States Agency for International Development (USAID) is now putting more emphasis on food safety. The Feed the Future Innovation Lab for Food Safety, led by Purdue University in partnership with Cornell University, aims to improve the production of and access to safe food in developing

countries. The “EatSafe – Evidence and Action Towards Safe, Nutritious Foods” project is led by the Global Alliance for Improved Nutrition (GAIN). It is focused on improving the safety of nutritious foods in informal market settings.

5) The COVID-19 pandemic has put a spotlight on fresh food markets and the bushmeat/wildlife trade; multiple reviews (e.g., Aiyar, 2020, Dobson, 2020) conclude safe food production and sourcing (e.g., livestock management to prevent spillover) are key to preventing future pandemics. The Feed the Future Innovation Lab for Food Safety developed and supported subject matter experts in target countries to help food processors navigate COVID-19 challenges to their productions systems.
6) The food safety flagship of the CGIAR research program on Agriculture for Nutrition and Health continues to generate evidence to support food safety mitigation in developing countries, especially for food sold in informal market systems.
7) World Food Safety Day, which is now observed every June 7 (since 2019), provides an opportunity to raise awareness about food safety and the shared responsibility among governments, producers, and consumers.

GFSP, hosted at the World Bank, is a public-private partnership that fosters capacity building on food safety. In 2018, the group developed a report on recent food safety investments in SSA. The goal of this report was to present country-specific data from GFSP in order to provide a clearer picture of the investment situation in East Africa. Because of a lack of coordination and transparency among donors, there are large knowledge gaps about what has been done to improve food safety as well as what is known about investment successes and failures. As described below, the GFSP database was reviewed, and projects specific to East Africa were extracted, summarized, and analyzed for trends and patterns.

Smart investing in food safety will make it possible to obtain region- or country-specific data on the pathogens of importance to food safety, the minimum and maximum levels at which they cause harm, and the likely impact of potential food safety issues. These findings can then be used to inform the investment needs of the region, including lobbying for increased donor support.

2.0 Methodology for the Review

2.1 GFSP database

The GFSP Food Safety in Africa database, released to the public in February 2019, contains information on 518 donor investments in food safety capacity building in SSA from 2010–2017. The projects were identified through internet keyword searches and validated with each of the 31 donors (United Nations organizations, bilateral donors, multi-donor trust funds, foundations, and development banks). Reports on Food and Agriculture Organization (FAO) and World

Health Organization (WHO) activities from the CAC Africa (FAO, 2012) and Capacity Building (FAO, n.d.) Committees were also used to identify projects and activities, as were communications from the World Trade Organization (WTO) Committee on sanitary and phytosanitary (SPS) regarding SSA-related technical assistance provided by the European Union, United States of America, Japan, and Canada since 2010 (WTO, 2015). Data on each project was obtained from official descriptions and report documents available online or through donors. Although it has not been updated to include 2018–2020 projects, the database is the most comprehensive compilation available and provides a reasonable basis for analyzing patterns and trends in food safety investments.

For the purposes of this project, food safety capacity building was defined broadly to include any investment or activity intended to improve the capacity of any individual or organization to play their role in making food safe. This included individuals and organizations in both the public and private sectors as well as individual consumers, NGOs, and others with roles in food safety. It did not include projects that did not specifically target food safety but might have had spillover food safety benefits (e.g., projects on water and sanitation or post-harvest management). Animal and plant health projects were not included unless food safety was stated as a primary goal or objective. Food safety as applied to subsistence farming, rather than markets, was not examined in depth. The mapping project did not assess either capacity building primarily funded by African institutions or national governments or investments by private global companies in the food industry.

For the present study, the database was sorted by country. Projects from Kenya, Tanzania, Uganda, Ethiopia, Rwanda, Burundi, and South Sudan were extracted. After the removal of duplicates, short-term trainings, workshops (less than one year in duration), and projects for which food safety was not the primary focus, 59 food safety projects in the East Africa region remained for analysis. New variables were added to capture project themes, points of intervention, and additional evaluation factors, where available. Analysis of the database was performed in Microsoft Excel (version 16.37).

The GFSP project also interviewed 99 key informants involved in food safety in SSA. Of these, 26 were from East Africa and 29 had experience working in the EAC. There was a mixture of long and short interviews, following a pre-tested template. Lessons learned were extracted from those respondents with experience in the EAC. Of these, 10 were working for the public sector, 10 for academia or research, six for the private sector, two for civil society, and one for an international government organization. These individuals had been in their positions for an average of eight years and can be considered experienced.

2.2 Description of projects

A systematic literature review of food safety interventions identified six factors critical for intervention success (Grace et al., 2018). The designs and outcomes of East Africa projects in the GFSP database were reviewed for examples of the following critical factors for success:

- acceptability
- feasibility
- sustainability
- scalability
- economic viability
- incentive for behavior change

Gender, nutrition, youth, and equity considerations of projects are also recognized as important and were captured as available. It was not possible to draw conclusions about the dataset as a whole due to a lack of detailed information regarding these parameters.

In addition to the critical factors for success, projects were assessed through an intervention matrix that was derived empirically from an assessment of the database. In this context, "intervention" refers to a classification of project activities according to type and targeted participant (value chain stakeholder). New variables were created by combining relevant activities recorded in the GFSP database, as follows in Table 1.

Table 1. Types of interventions applied to improving food safety

Intervention variable	Relevant GFSP activity variables
Technologies	• residue sampling and testing • transport/cold-chain technology
Training	• public sector staff training/certification • private sector extension/education/training • laboratory methods and training
Information	• risk assessment • disease surveillance • public awareness campaigns
New processes	• research on hazards and interventions • traceability systems
Organizational arrangements	• certification/compliance for export • private audits/certifications
Policymaking/regulation	• legislation/policy/standards development • regulatory compliance (including inspection and enforcement)
Infrastructure	• processing facilities/equipment • laboratory facilities/equipment

This was then combined with data about the value chain participant(s) involved in project interventions (interventions not in the database are added in text). Based on the findings from the database and interviews, as well as their own experience, the authors gave a semi-quantitative score to the investment level in different interventions at different points in the value chain.

3.0 Results

3.1 Stakeholder interviews

Expert knowledge is quite high. Most considered biological hazards more important than chemical hazards. This is not often the case when surveys are conducted among laypeople or decision-makers and indicates a good understanding of FBD causation, as currently known.

***Involving the private sector is essential but inadequate*.** The great majority (87%) considered public-private collaboration for food safety very important, implying greater involvement of the private sector in food safety initiatives. However, 50% considered joint public and private initiatives effective only in a limited manner, while only one person considered them "very effective." Examples of "somewhat effective partnerships" included the Aflatoxin Proficiency Testing and Control in Africa (APTECA), set up by Texas A&M University; the National Food Safety Coordination Committee (NFSCC) in Kenya; and training in SPS, which was mentioned by several respondents.

Investments considered to have limited or no effectiveness included farmer co-operatives in Tanzania; a trade association in Uganda; export companies in Kenya (because of limited spillover to local markets); taskforces that did not involve the private sector; and taskforces, frameworks, and initiatives that could not be fully implemented due to lack of public sector capacity. Given the rather limited success of public-private engagement, participants were asked for suggestions on improving collaborations. Most suggestions related to improving dialogue between government and the private sector. Respondents from the private sector emphasized more government investment in food safety infrastructure, compensating the private sector for the additional costs of food safety, transferring more responsibility to the private sector (reasons cited included "public systems are not working" and "more voice for the private sector"), and more government accountability. On the other hand, one public sector respondent called for more "honesty and transparency" from the private sector.

Capacity building is common but reaches very few and focuses on export. In all, 87% of respondents had been involved in capacity building in food safety, mainly as recipients of training from external agencies. Most training received was on SPS, standards and certification, and laboratory techniques. Training benefited few entrepreneurs (typically less than 100) or farmers (typically several thousand). One exception was a training that reached 3,000–4,000 veterinarians. The participants were not able to give information on the effectiveness of training.

Many barriers exist to food safety beyond lack of resources. Given that survey participants typically name additional resources as their chief need, we asked them to assume that resource requirements were met and then asked them to cite additional barriers to food safety.
The main barriers included:

- Unethical behavior (rule-breaking for economic profit, unscrupulous practices by the private sector, lack of ethics, recipients misappropriating donor money)
- Limited regulatory enforcement capacity (mentioned several times)

- Lack of a culture of food safety in the private sector (mentioned several times)
- Poor coordination among government agencies (mentioned several times)
- Excessive and costly bureaucracy
- Limited trust between government and private sector
- Training is necessary but insufficient; the private sector needs to be motivated to train by enforcement or consumer demand
- Consumers prefer unsafe food because it is affordable (mentioned several times)
- Consumers don't have a culture of appreciating traceability, labeling, or packaging
- Complexity of food systems and huge numbers of players
- Lack of consumer, producer, and government awareness (mentioned several times)

Understanding gender aspects is key to food safety but often ignored. We asked respondents how gender should be taken into account in food safety initiatives. Unlike the previous questions, which had high response rates, 53% of the respondents had no opinion or did not reply. This suggests that gender and food safety has been neglected in capacity building. Of those respondents who did reply, the responses were overwhelmingly in favor of taking gender into account. The following points were submitted:

- Gender differences need to be considered from the start
- Women and men have different risk exposures
- Since women are heavily involved in production and handle most foods, they should also be involved in food safety decision making and prevention efforts
- Many women are involved in street vending

Respondents also pointed out barriers. For example, even though women are responsible for procuring and preparing food, they lack control over household resources.

Ways to overcome barriers were also cited:

- Consider women's barriers, workloads, etc. in planning initiatives
- If women represent 80% of retailers, then they should be 80% of trainees
- Collect gender-disaggregated data

Donor investments have benefited more consumers outside of Africa than within Africa. Although there were few responses to a series of questions on the beneficiaries of previous food safety investments, the consensus was that most benefits went to African exporters and consumers of exported food. This reflects a donor focus on exports and on improving national public sector capacity to support exports. It is related to the at-the-time new and widespread focus of many donors in the first decade of the 21st century on "Trade, Not Aid." The idea was

that poor countries could "trade their way out of poverty" following the example of the Southeast Asian countries of South Korea, Hong Kong, Taiwan, and Singapore, which had witnessed rapid economic growth. Unfortunately, this hypothesis has not held up well in Africa.

Successful approaches. Participants were asked about direct experiences with successful projects. Most were able to give examples; however, in most cases, they were not able to describe any impacts and gauged success by the appreciation of the beneficiaries (as one respondent noted, "There is limited project follow-up in most cases and assessing their success or failure becomes a problem."). Again, in most cases, there were very few beneficiaries (e.g., training 25 street vendors in Nairobi). Several respondents considered projects on export successful. Others said they did not know of any successful food safety investments.

Potential pitfalls. Failure to implement regulatory frameworks was mentioned by several respondents. Other examples of failure cited incidences when the government captured all a project's resources. Standalone workshops without follow-up were considered to have little impact, as were trainings without hands-on, practical experience. Again, lack of follow-up impeded learning whether the project was a success or failure.

Impacting the informal sectors. We asked participants their opinions on the informal sector selling most of the food consumed in EAC. Participants agreed the informal sector was vital for food and nutrition security but was "ignored or banned" by authorities, as the majority are not licensed. Training, certification, and branding were mentioned by many respondents as a possible solution. One respondent suggested a more supportive relationship. Currently, if regulators encounter unlicensed vendors, their businesses are closed (without being given much support). Instead, it was suggested that vendors should be given assistance and a time frame for gradual improvement. Several respondents pointed out it was not possible to just close the informal sector, as it is too large. Several suggested that informal sector actors should form associations to amplify their voices and power and facilitate interaction with regulatory authorities.

Signs of progress. Respondents were also asked to identify signs of food safety improvement in the East Africa region over the last decade. Answers included increasing regional trade, trade to the Middle East, more international exports, increased awareness of food safety, and increased use of Good Manufacturing Practices. However, many respondents did not provide an answer. It seems that the large investments in trade and, to a lesser extent, the formal sector have had benefits, but there have been few reportable improvements in the informal markets where most buy and sell.

Food safety goals. The last question focused on goals for food safety over the next decade. Participants identified the following priorities:

- Raising awareness to put food safety on the agenda or prioritize it (mentioned several times)
- Testing alternative models for food safety interventions in informal sectors
- Collecting stronger evidence about food safety, including economic impacts
- Integrating the informal sector more effectively into the food system
- Improving capacity of the formal and informal private sectors
- Committing to enforcement (mentioned several times)
- Improving governance and infrastructure (mentioned several times)
- Creating systems for food safety emergencies
- Improving laboratory capacity and inspection
- Strengthening participation in CAC (African participants are funded to attend but often feel they do not have much influence)
- Establishing a food safety agency for Africa

3.2 Descriptions of the projects analyzed

Number and distribution of projects. In total, 59 food safety projects were analyzed from 19 donors. Approximately half (28) of the projects were implemented in just one country. Six were implemented in two countries, 21 were implemented in between three and nine countries, and four were implemented in 10 or more countries (Figures 1 and 2). In total, 58% of the projects were implemented only in the seven countries of East Africa, while the other 42% of projects included some implementation in countries outside of the region.

Figure 1. Geographic distribution of food safety projects in the East Africa region (2010–2017)

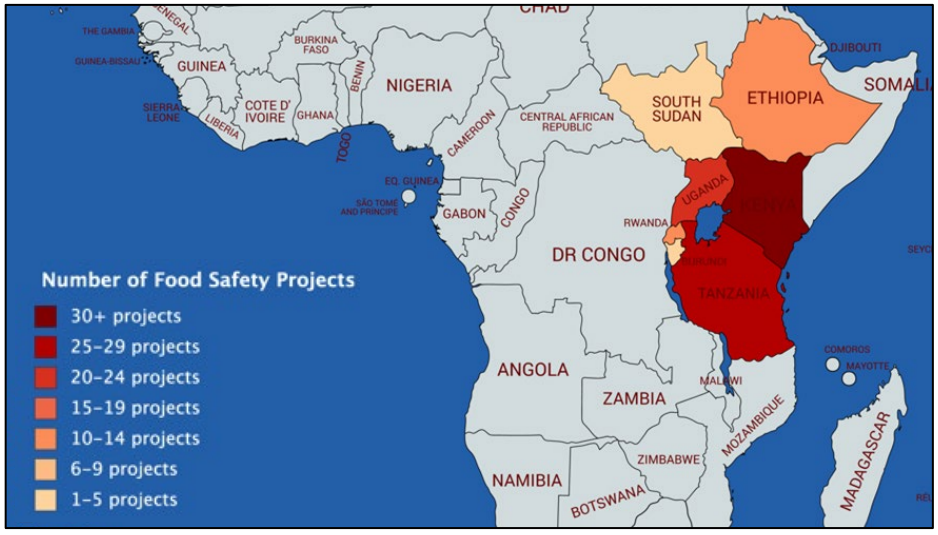
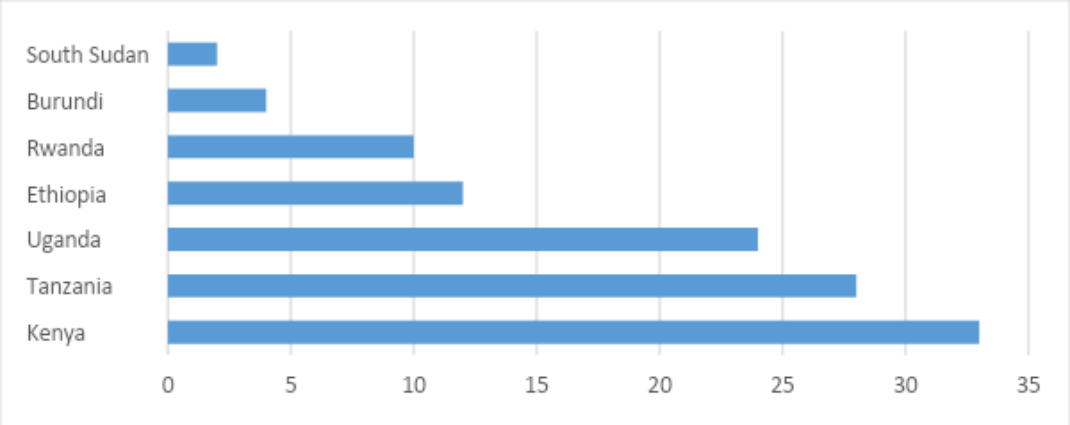


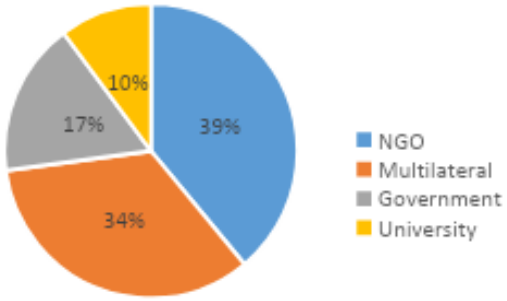
Figure 2. Number of food safety projects analyzed (2010–2017)



Between 2010 and 2017, Kenya had the most projects of any country in East Africa (33), followed by Tanzania, Ethiopia, and Uganda (28, 24, and 12, respectively). Rwanda had 10 projects. Burundi only had four projects, and South Sudan had the fewest (two). In the full GFSP database, which covered all of SSA, South Sudan also ranked in the bottom four countries in terms of project number (along with Equatorial Guinea, Sao Tome and Principe, and Somalia).

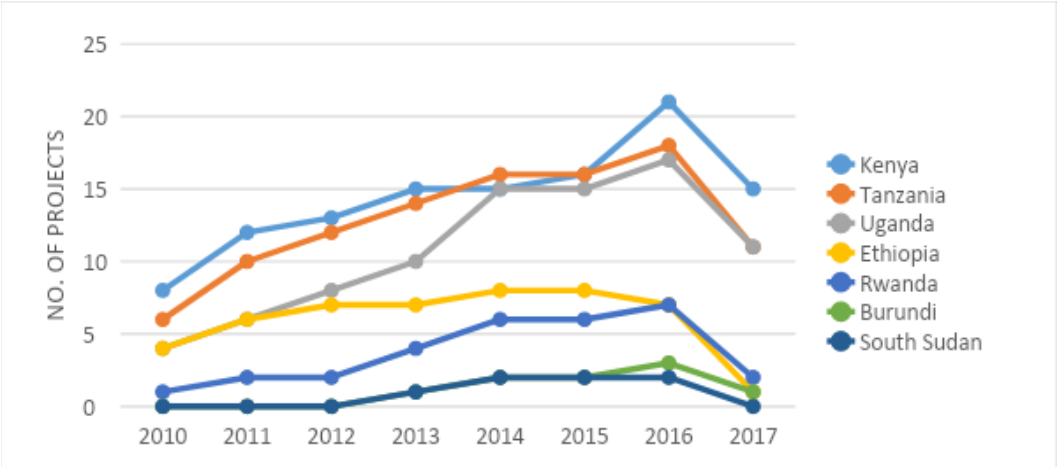
Implementing organizations of East Africa food safety projects. NGOs and multilateral organizations (such as FAO and WHO) implemented nearly three-quarters of the food safety projects in East Africa. Specifically, the most common implementers were CGIAR centers (International Institute of Tropical Agriculture [IITA], International Food Policy Research Institute [IFPRI], International Crops Research Institute for the Semi-Arid Tropics [ICRISAT], International Livestock Research Institute [ILRI]), the Europe-Africa-Caribbean-Pacific Liaison Committee (COLEACP), FAO, and WHO. Academic centers such as the University of Nairobi (Kenya), the University of Georgia (United States), and the University of Glasgow (Scotland) were responsible for implementing 17% of projects (Figure 3).

Figure 3. Implementing organizations of food safety projects in the East Africa region (2010–2017)



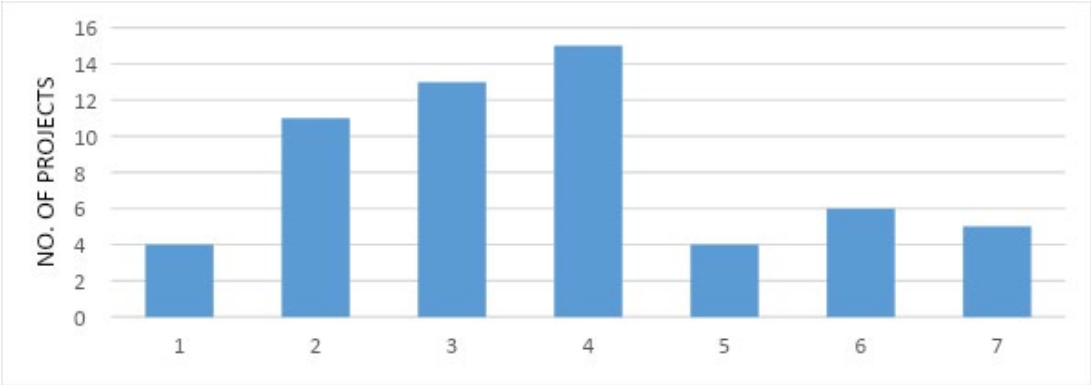
Time of implementation. Between 2010 and 2017, the number of food safety projects generally increased over time for all seven countries in the region (Figure 4). There were consistently more projects in Kenya, Tanzania, and Uganda relative to the other four countries. There was a 50% increase in Uganda projects from 2013 to 2014; however, the five new projects did not seem to share a common cause, theme, or donor. As noted earlier, data for 2017 projects was incomplete at the time of analysis, thus the apparent downturn in the number of projects is almost certainly artificial.

Figure 4. Number of food safety projects in the East Africa region over time (2010–2017)



Duration of projects. Most East Africa food safety projects were between three and four years in duration. There were several examples of projects that continued into a second phase (e.g., MyDairy I/II; Safe Food, Fair Food I/II; Partnership for Aflatoxin Control in Africa [PACA] I/II, etc.) after demonstrating success in the first phase. In addition, 11 projects were six to seven years in duration. These longer-term investments focused on aflatoxin, pesticides, national control systems, and food safety for export (Figure 5).

Figure 5. Duration of food safety projects in the East Africa region by number of years (2010–2017)

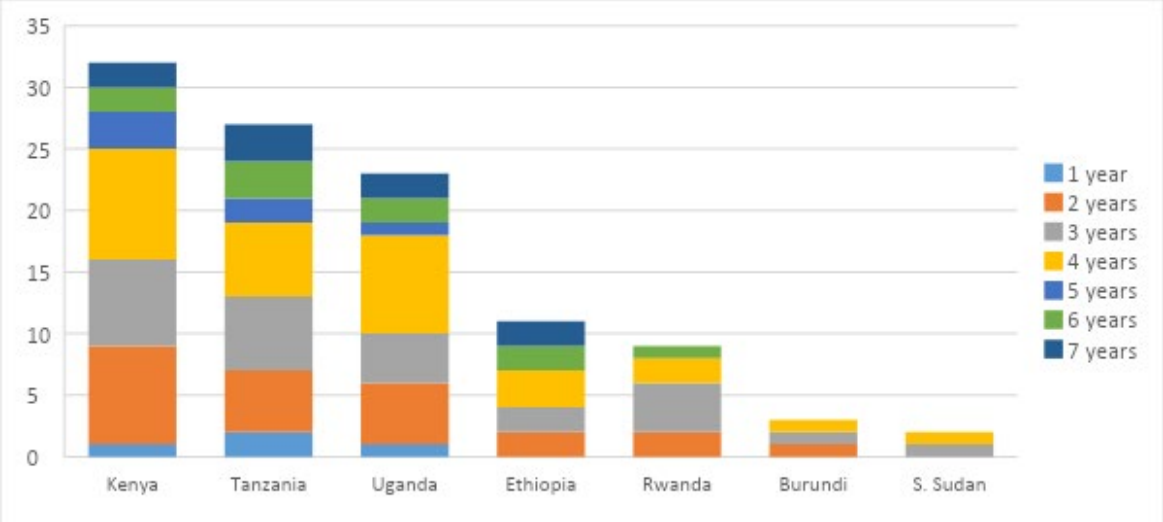


Uganda and Ethiopia had the longest median project length (four years), while Burundi had the shortest (two and a half years) (Table 2; Figure 6).

Table 2. Median length of East Africa food safety projects, by country (2010–2017)

Country	Years
Kenya	3
Tanzania	3.5
Uganda	4
Ethiopia	4
Rwanda	3
Burundi	2.5
South Sudan	3.5
All East Africa	4

Figure 6. Duration of projects, by country (2010-2017)



Note: There were 137 short-term East Africa food safety investments (less than one year) also recorded in the GFSP database; however, these were not included in this analysis. Almost all of these shorter projects were technical assistance trainings/workshops lasting only a few days.

Foods and hazards addressed. All seven countries had food safety investments in aflatoxin mitigation in grain and legumes (especially maize and groundnut, respectively). Additional context regarding investments in aflatoxin mitigation is included in the next section, as well as in the discussion. However, while aflatoxin has long been regarded as a key food safety issue in Africa, the FERG data suggests that other hazards have a much greater impact on public health and might also be more amenable to solutions.

ASF (such as meat, fish, and dairy) and microbiological hazards were addressed in all countries except Burundi and South Sudan. Specific microbiological hazards (and proxies for hazards, such as coliform bacteria) targeted for interventions included *Escherichia coli, Salmonella* spp*., T. solium, Toxoplasma* spp*., Listeria* spp*., Vibrio* spp*., Campylobacter* spp*., Bacillus* spp*.,* and *Paragonimus*. As discussed earlier, this food-hazard pairing has been responsible for a significant proportion of the FBD burden in Africa.

While microbiological hazards in fresh produce were not a major food safety focus in any of the East Africa countries (see discussion for possible reasons), a few projects addressed pesticides in fruit and vegetable value chains in Kenya, Tanzania, Uganda, and Ethiopia. These investments were generally aimed at improving food safety in order to expand market access (such as for export to the European Union), strengthening agricultural trade and livelihoods. Additional high-value export foods targeted included coffee, cashews, and chilies, which can contain chemical food hazards (pesticides and aflatoxin) but are not especially vulnerable to

microbiological hazards. Based on project descriptions, these investments likely had a limited direct impact on food safety for African consumers.

Project themes. In terms of central project themes (Table 3), aflatoxin mitigation (41%, or 24 of the 59 projects) and national control systems (37%, or 22 of the 59 projects) predominated. Investments in aflatoxin mitigation largely occurred in Kenya, Tanzania, and Uganda. Fourteen projects examined animal health and food safety in the context of value chain analysis, such as dairy development. Only 29% of the countries had three or more projects aimed at improving surveillance and/or laboratory testing. Among the themes with the least number of projects overall were research on the links between aflatoxin and human health (such as child stunting), consumer education, Codex capacity building, malnutrition/food hygiene, infrastructure investment, pesticide residue analysis, private certification schemes, and food fraud/adulteration.

Table 3. Main project themes among East Africa food safety investments

Main project themes*	Kenya	Uganda	Tanzania	Rwanda	Ethiopia	Burundi	South Sudan	Total**
aflatoxin burden	2	2	3	0	0	0	0	4
aflatoxin detection	3	4	4	1	2	0	0	10
aflatoxin mitigation	16	8	12	3	2	1	1	24
animal health and food safety	11	5	6	3	3	2	0	14
Codex capacity building	2	2	2	1	0	1	1	3
consumer education	1	0	2	1	1	0	0	4
food fraud/adulteration	0	1	0	0	0	0	0	1
food hygiene and malnutrition	1	1	1	1	1	0	0	3
food safety for export	3	3	3	0	1	0	0	7
foodborne disease/hazard surveillance (including lab testing)	6	2	4	2	1	1	0	7
infrastructure investment	2	1	1	1	1	0	0	3
national control systems	11	9	8	4	3	3	2	22
pesticide residue analysis	2	1	1	0	1	0	0	3
private certification	2	0	0	0	0	0	0	2
risk analysis/assessment	6	3	5	1	2	0	0	9
value chain analysis	8	2	5	1	2	1	0	11

**The categories are not mutually exclusive (i.e., one project might touch on several themes), and a single project may involve multiple countries.*

A total of 27 projects addressed aflatoxin risk in East Africa. Approaches most commonly focused on the development and implementation of mitigation measures and/or detection technology, and there was limited research into the ill health effects of aflatoxin consumption. Among these projects, PACA is unique in addressing the entire value chain; however, the new Tanzania Initiative for Preventing Aflatoxin Contamination (TANIPAC) investment (by Global Agriculture and Food Security Program [GAFSP]/African Development Bank [AfDB]) also appears to be relatively comprehensive.

An examination of the target audience of aflatoxin interventions in the database revealed the following:

- Much of the aflatoxin project work took place in labs and/or on farms. Producers targeted within aflatoxin projects were primarily smallholder farmers. Extension workers and on-farm technical staff were also trained in several projects.
- Only four projects included millers/processors and traders in activities, which is somewhat surprising given the importance of proper storage to aflatoxin mitigation. Rather than approach individual businesses, partnerships with trader organizations were used to maximize project reach. For example, the Storage and Drying for Aflatoxin Prevention Project (AflaSTOP) for drying techniques and postharvest storage structures secured the involvement of the Eastern African Grain Council (EAGC), which includes 450 members.
- The database only noted the inclusion of retailers/retail groups in three aflatoxin projects. This is likely because aflatoxin contamination of food occurs earlier in the production chain. Other than possible testing/certification of the products they sell, retailers' role in reducing aflatoxin risk is relatively limited as compared with other hazards. (Refer to the Marketing Food Safety in Kenya project [funded by USAID] for research on certification schemes.)
- Consumer education surrounding aflatoxin was addressed by eight projects. Although their food handling and cooking practices are not relevant to aflatoxin contamination, informed consumers may choose to pay a premium for products that have been certified as "safe," thereby incentivizing upstream food system actors.

A broad assessment of local capacity for food safety or hazard education was not noted as a theme of 2010–2017 investments.[1] However, trainings within both the private and public sectors were common project activities, and food safety capacity building specific to laboratory

[1] Recent projects funded by the European Community and FAO are building educational capacity and may include this type of assessment.

methods was included in nearly one-third (29%, or 17) of the projects. In terms of more formal education, many projects included long-term training of local M.S. and Ph.D. students and fellows in their research and/or interventions.

Fifteen projects included consumer education on food safety. For example, Innovative Communication Media and Methods for More Effective Aflatoxin Mitigation in Groundnut (ICMM), funded by the McKnight Foundation, used an informal learning alliance approach and also tested the effectiveness of leaflets, radio, and video in increasing awareness and understanding of aflatoxin mitigation and management. The WHO's Five Keys to Safer Food is another notable example of a food safety education campaign in the East Africa region. Some projects that had a partial focus on food safety were not included in this analysis as it was not possible to disentangle food safety elements.

The evaluation section that follows contains more detail on interventions by value chain participants.

Intersection between food safety and nutrition, food security, and trade projects in East Africa. The full GFSP database (for all of SSA) includes a large number of projects focusing on nutrition, food security, and trade which also included food safety activities. These projects were not considered in the East Africa investment analysis; however, representative examples include the Fit for Market projects supported by the European Community (EC) in Burundi, Ethiopia, Kenya, Rwanda, Tanzania, and Uganda, which allow smallholder farmers, producer groups, farmer organizations, and SMEs to access international and domestic fruit and vegetable markets by complying with the SPS standards and market requirements. The total budget for all countries was $27,658,063, with an estimated $11,063,225 dedicated to food safety. The Japan International Cooperation Agency (JICA) Safe Milk Promotion in Mbarara project in Uganda provided technical assistance to increase milk production, quality, and safety through improved dairy hygiene, tick-borne disease control, and reproduction management. The total project budget was $487,050, of which an estimated $194,820 was dedicated to food safety.

3.3 Amount of investments/number of projects

Food safety investment, by country. Food safety investments in the East Africa region ranged from $15,750 to more than $33M (USD) (Table 4). For Kenya, Tanzania, Uganda, and Ethiopia, the average (median) spend was around $1M-$1.5M per project. According to the available data, Rwanda, Burundi, and South Sudan had significantly less food safety investment. High-

budget outliers included PACA and the Aflasafe Technology Transfer and Commercialization initiative (ATTC), both of which focused on aflatoxin, and the recent TANIPAC aflatoxin investment in Tanzania with considerable financial support from the Tanzanian government. Low-budget outliers (<$100,000) included a food fraud project in Uganda, aflatoxin research, and evidence-informed decision-making for food safety policy (also in Uganda). Food safety budgets were not available for 16 projects.

Table 4. Distribution of East Africa food safety investments (2010–2017), by country

Country	Mean Budget ($)	Median Budget ($)	Minimum Budget ($)	Maximum Budget ($)*	Unknown**
Tanzania	6,300,130	1,409,904	151,000	33,600,000	7
Uganda	5,369,850	1,176,550	15,750	33,600,000	7
Kenya	2,929,142	1,184,310	185,361	20,000,000	10
South Sudan	2,316,227	2,316,227	299,000	4,333,455	0
Ethiopia	1,712,946	1,233,595	302,622	4,333,455	2
Burundi	1,625,350	299,000	243,597	4,333,455	1
Rwanda	1,498,541	296,500	221,195	4,333,455	4
All East Africa	3,035,976	768,647	15,750	33,600,000	16

**In many cases, the maximum budget represents a multi-country project (not all of these funds were dedicated to a single country, nor necessarily all in East Africa). Unfortunately, budget data were not available on a country-by-country basis for these projects. It is not possible to give a "total" investment for each country because of these multi-country investments.*
***Unknown = number of projects for which the food safety project budget was not publicly available.*

The database contained three food safety investments over $20M. All were concerned with aflatoxin mitigation, and all were implemented, at least partly, in Tanzania. For PACA and ATTC, this number represents the total budget of multi-country projects; thus, countries in other regions also received some of the project's available resources. In the case of PACA, one-third (two out of six) of the pilot countries were in the region—Uganda and Tanzania. Similarly, the ATTC project was implemented in Kenya, Uganda, and Tanzania as well as Burkina Faso, Gambia, Ghana, Malawi, Mozambique, Nigeria, Senegal, and Zambia.

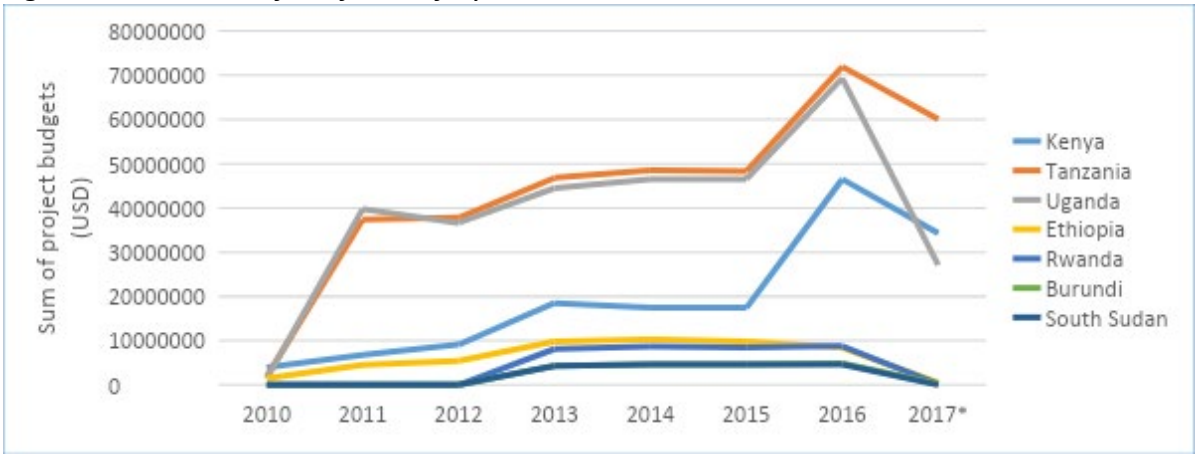
Food safety investment by donor. Between 2010 and 2017, 19 international donors invested $142,154,706 in food safety projects that were at least partially implemented in East Africa (Table 5, Figure 7; note that the total by donor is not listed because it is difficult to separate spending by country in multi-country projects). Thirty-four (or 58%) of projects were *only* implemented within East Africa. Altogether, the known budgets of these projects totaled $57,198,447 with a median budget of $389,817. (Notably, all of FAO's projects were implemented within the East Africa region only, and not in other countries.)

*Table 5. Amount of East Africa food safety investments (2010–2017), by donor and country, in USD**

Donor	Kenya	Tanzania	Uganda	Ethiopia	Rwanda	Burundi	South Sudan
United States	16,633,455	39,933,455	18,713,455	4,833,455	6,354,650	4,333,455	4,333,455
Bill & Melinda Gates Foundation	13,120,000	24,000,000	35,800,000	.	1,800,000	.	.
GAFSP/AfDB	.	33,000,000	.	.	.	.	.
United Kingdom	8,771,940	1,600,000	1,600,000	.	.	.	.
Germany	1,233,596	2,643,499	1,409,904	2,643,500	.	.	.
Standards and Trade Development Facility (STDF)	2,248,760	1,064,450	2,248,760	.	.	.	.
Sweden	243,597	2,421,898	243,597	.	243,597	243,597	.
EC	1,747,533	676,318	1,527,275	302,622	.	.	.
FAO	726,000	800,000	409,975	.	593,000	299,000	299,000
Finland	3,622,941	.	.	.	.	.	.
Australia	1,529,000	1,529,000	.	.	.	.	.
WHO	n/a	n/a	n/a	n/a	n/a	n/a	.
Japan	.	.	.	2,960,500	.	.	.
Alliance for Accelerating Excellence in Science in Africa (AESA)	775,293	775,293	.	.	.	.	.
McKnight	n/a	996,000	n/a	.	n/a	.	.
FAO/WHO	n/a	.	n/a	794,155	.	.	.
Denmark	817,249	.	.	.	.	.	.
France	.	.	.	352,635	.	.	.
Canada	238,353	.	.	.	.	.	.

**As with Table 4, the analysis includes budgets for multi-country projects. Thus, not all of the funds listed were dedicated to the individual country (nor East Africa). However, it is indicative of the scope of donor projects in each country.*

Figure 7. Total East Africa food safety investment over time, all donors



** Data for 2017 is incomplete and project budget estimates may be distorted by multi-country projects.*

The 2011 jump in investment in Tanzania and Uganda is attributable to PACA ($33.6M, multi-country project), while the 2016 peak in Kenya and Uganda is linked to ATTC ($20M, also multi-country). In Tanzania, PACA and AflaSTOP ended in 2016, but the ATTC project began in the same year. The largest East Africa food safety investment analyzed is the aflatoxin project known as TANIPAC, funded by GAFSP and AfDB. This is a targeted $33M food safety investment in Tanzania that began in 2017 and extends to 2023.

Average investment in East Africa projects, by donor. GAFSP is responsible for $20M, while AfDB has committed to providing a $13M loan (Table 6). Among donors, Canada, France, and the FAO had the lowest average project budgets. For the Bill & Melinda Gates Foundation, the average project budget was significantly higher than the median due to a single outlier (PACA). Similarly, the United Kingdom project budgets ranged widely, from approximately $1.6M to $7.2M (a 2016–2019 investment in antimicrobial resistance [AMR] related to ASF).

Table 6. Distribution of East Africa food safety investments (2010–2017), by donor, in USD (indicates donors with only one project documented with a known budget)*

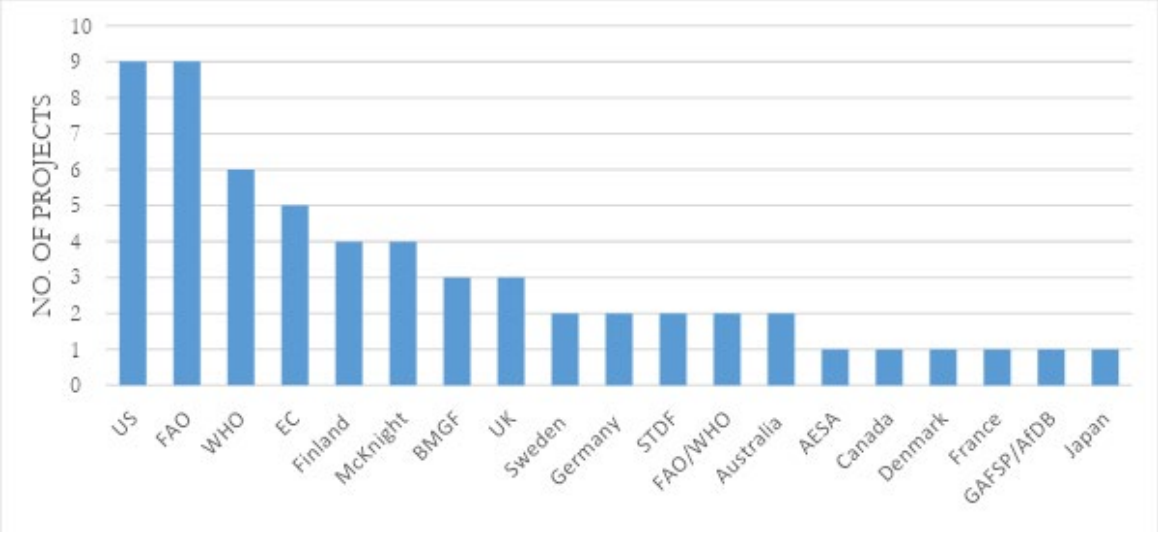
Donor	Mean Budget	Median Budget	Minimum Budget	Maximum Budget	Unknown Budget
United States	4,809,108	3,066,728	221,195	12,000,000	3
FAO	233,139	294,000	15,750	427,000	2
WHO	n/a	n/a	n/a	n/a	6
EC	850,750	676,319	302,622	1,747,533	0
Finland	905,735	731,742	185,361	1,974,097	0
McKnight	498,000	498,000	234,000	762,000	2
Bill & Melinda Gates Foundation	7,424,000	4,000,000	1,320,000	20,000,000	0
United Kingdom	3,457,313	1,600,000	1,570,349	7,201,591	0
Sweden	1,210,949	1,210,949	243,597	2,178,302	0
Germany	1,321,750	1,321,750	1,233,596	1,409,904	0
STDF	1,124,380	1,124,380	1,064,450	1,184,310	0
FAO/WHO*	794,155	794,155	794,155	794,155	1
Australia*	1,529,000	1,529,000	1,529,000	1,529,000	1
Alliance for Accelerating Excellence in Science in Africa (AESA)*	775,293	775,293	775,293	775,293	0
Canada*	238,353	238,353	238,353	238,353	0
Denmark*	817,249	817,249	817,249	817,249	0
France*	352,635	352,635	352,635	352,635	0
GAFSP/AfDB*	33,000,000	33,000,000	33,000,000	33,000,000	0
Japan*	2,960,500	2,960,500	2,960,500	2,960,500	0

Note: In cases where more than one donor contributed to a food safety project, only their contribution was used for calculations. The table includes budgets for multi-country food safety projects (entailing work possibly outside of East Africa). For the handful of jointly funded projects, individual donor contributions were noted and tracked through spreadsheet comments.

Once again, it is important to note that analysis of investment size is distorted by the large regional (outside of East Africa) budgets; however, budgets for single countries were unfortunately not available.

Number of East Africa food safety projects, per donor. The United States and FAO funded the highest number of projects in the East Africa analysis (Figure 8). All of the U.S. projects were funded by USAID[2], including programs such as the Feed the Future initiative's Innovation Lab for Collaborative Research on Peanut Productivity and Mycotoxin Control (three projects), Africa RISING (one project), and the Global Center for Food Systems Innovation Lab (one project). Three U.S. projects were funded through cost-sharing mechanisms (such as the Global Development Alliance) with other donors: PACA, ATTC, and AflaSTOP Post Harvest Storage Structures.

Figure 8. Number of food safety investments in East Africa (2010-2017), by donor



Among the 34 projects that were implemented within East Africa only, FAO funded the most (nine projects), followed by USAID (five projects), EC (four projects), and Finland (4 projects).

3.4 Trends in food safety investment

As noted in the larger GFSP analysis, the following patterns in donor investment also emerged in East Africa:

Focus on trade in regional and overseas markets

- Bilateral donors, such as the European Union, aim to support development through export trade and to protect European consumers of food produced in Africa. The concept of "Trade, Not Aid" was very prominent in the first decade of the 2000s.

[2] USDA did not appear as a funder in the EA analysis. USDA was represented in the full GFSP analysis; however, these projects were often short-term trainings and/or had a mixed focus (food security or trade).

However, it is now recognized that Africa is increasingly an importer of food, and its potential to export food may be limited to niche markets.

- Many East Africa countries have long depended on traditional export commodities (such as coffee in Ethiopia). They are benefitting from expanded market access for fruits and vegetables, which requires demonstration of food safety compliance (such as meeting international standards for pesticide residues).
- Within Africa, food security and nutrition have had a higher priority than food safety for domestic consumers. In 2015, WHO-FERG published burden-of-illness estimates, which elevated visibility and concern around food safety. This may account for the apparent increase in food safety investment in recent years.
- The African Continental Free Trade Area includes an annex dedicated to SPS and is expected to significantly increase regional trade (including agri-food products). In recent months, the African Union Department of Rural Economy and Agriculture (AU DREA) has prepared an SPS Policy Framework, which defines many needs for future food safety investment (e.g., infrastructure, surveillance, online platforms for knowledge sharing, and centers of excellence for professional training).

Geographic concentration

- European Union food safety investment is concentrated in Kenya, with which it has a significant food agricultural trading relationship. Kenya also has a longer track record in exporting products than some of the other EAC countries.
- U.S. food safety investment is focused on countries that are participants in its Feed the Future initiative to improve food security through agricultural development and trade, including Kenya and Uganda. In addition, the United States has invested in Tanzania through its ATTC program.
- The disparity between these countries and Rwanda, Burundi, and South Sudan, which had significantly less food safety investment, may be attributed to existing relationships with development partners, historical relationships dating from colonialism, the potential for export, and, in the case of South Sudan, its instability and relative newness as a country.

Focus on national control systems

- National governments play a role in overseeing exports and have received significant donor investment in training and laboratory capacity to support that role.
- WHO and FAO are country member-driven United Nations agencies that naturally focus on national control systems and other government capacities as a function of their roles.

- The SSA governments tend to partner with WHO, FAO, and other donors who frequently prioritize government staff training, policy and standard development, and lab capacity.

Focus on aflatoxin

- Aflatoxin has gained significant visibility in SSA as a toxic chemical hazard posing chronic and acute health risks, especially for the rural poor, whose diets depend heavily on affected commodities such as maize and groundnuts.
- Aflatoxin also affects commodities with potential opportunities for trade within SSA and overseas that require the assurance of food safety to be fully realized.
- African governments are increasingly recognizing the link between aflatoxin and the urgent priorities of food security (as affected by post-harvest loss) and nutrition (based on aflatoxin's possible contribution to stunting among children).
- On average, aflatoxin mitigation projects have a higher budget than projects focused on other food safety themes.
- Aflatoxin's health burden is very low compared to other hazards, but it has been shown to be a problem in some areas. The high investments reflect concern following a few highly publicized outbreaks that resulted in deaths of tens or hundreds of people as well as strong advocacy for investments in aflatoxins. Moreover, aflatoxins are frequently implicated in export rejections, and there is uncertainty about their health impacts, which leads to additional concerns.

***Challenges to understanding the full health burden of aflatoxins*.** Childhood stunting has been shown to be strongly associated (that is, correlated) with aflatoxin consumption in some, but not all, studies. Correlation does not imply causation, and epidemiology provides a set of tools to help understand whether association is causal or due to confounding. However, the health burden of aflatoxin in children is complex in that children, especially <2 years, are still developing metabolic functions in the liver necessary to detoxify aflatoxin and other toxins. The interface of age, development, and aflatoxin dose complicates the measurable impacts on children's health and growth.

In the case of aflatoxins, epidemiologists look for the following:

- A temporal relationship in which the exposure precedes the development of disease. Most studies on aflatoxin and stunting have been cross-sectional, so it is not possible to see which came first. Two studies have shown exposure to aflatoxins came before stunting.

- Biological plausibility as suggested by laboratory and animal studies. Many studies show that aflatoxins have pathological effects on cells (including human cells) and metabolism. However, it is not known if the amounts consumed by children are high enough to result in the proposed growth impairment effects. In toxicology, the dose makes the poison. A toxin that has pathological effects at one dose might have no adverse effects, or even positive effects, at a lower dose.

- Animal studies showing health impacts. A larger number of experimental studies have shown that aflatoxins lead to reduced weight gain and other health problems in animals. However, in most of these studies, aflatoxins were administered every day at high to very high doses over short periods of time. This differs from the type of exposure typically experienced by children. Moreover, there is a very wide species variation in susceptibility to aflatoxins. For example, mature chickens can tolerate aflatoxin at hundreds of times the amount that sickens day-old ducks. It is not clear where humans are in terms of relative susceptibility.

- Exposure that exceeds the thresholds necessary for effect. Most animal studies show a threshold below which effects are not seen, but this is not constant across different studies. Species, strain, sex, age, diet, exercise, and length of exposure all influence the threshold at which no effects are seen and the tolerance to higher doses. We do not know if the amount of aflatoxins consumed by children is over or under a threshold necessary to cause growth impairment.

- A dose-response relation. Animal studies have shown a clear dose-response effect on weight gain, but only over a relatively high range of doses. Some studies even find that aflatoxins stimulate growth at extremely low doses.

- Replication over studies. Several studies have shown associations between aflatoxins and growth outcomes, but there are other studies that do not support these findings and do not show any association.

See Grace et al., 2015 for further discussion and references.

3.5 Recent projects (not included in the GFSP database)

A full accounting and analysis of projects implemented after 2017 was not able to be completed within the East Africa report timeline. However, 16 relevant projects from nine donors were identified (Appendix E):

- Bill & Melinda Gates Foundation/Department for International Development (DFID): four projects totaling around $11.3M (2018–2022), all with a heavy focus on food safety for African consumers
- European Union: four projects totaling $69.5M (2018–2024); however, food safety was only one element of food security or trade-focused projects
- STDF: three projects totaling $2.3M (2018–2022), emphasizing market access
- FAO: two projects (2017–2020), budgets not available, on street food and food safety education
- United States (Defense Threat Reduction Agency [DTRA] and Department of Agriculture [USDA]): two projects (2016–2018), budgets not available
- Sweden (2017–2021): one project (2017–2021) at $3.2M, the International Training Programme on Animal Health and Food Safety

Although they might not be representative of all East Africa food safety investments in recent years, the following trends were noted among these projects:

Export capacity continues to attract targeted investment. In addition to their Improving Sanitary Capacity to Facilitate Livestock and Meat Exports project described above, STDF is also investing in market access for the fruit and vegetable sector in Uganda. A third project, Mainstreaming SPS Investments into the Comprehensive Africa Agriculture Development Programme and Other Frameworks, is using the evidence-based Prioritizing SPS Investments for Market Access (P-IMA) tool to help Ethiopia, Kenya, Rwanda, and Uganda prioritize SPS investments for market access.

The European Union has invested heavily in export capacity among the EAC countries. The Market Access Upgrade Programme (MARKUP), 2018–2023, with a budget of $44.2M, supports national partners to address market access constraints as well as the EAC Secretariat to coordinate selected region-wide policy and regulatory capacities. A smaller EC project in Rwanda ($333,904, 2018–2020) was focused on providing technical assistance to the National Agricultural Export Development Board and its export laboratories.

Focus on ASF in Ethiopia. The Bill & Melinda Gates Foundation/DFID, STDF, and the EC all funded projects to improve food safety in ASF (milk and dairy products, meat) in Ethiopia. The largest, an EC investment called Health of Ethiopian Animals for Rural Development (HEARD) ($17M, 2018–2022), is working to build Ethiopia's capacity for food safety of animal source products as well as strengthening control of zoonotic diseases through improved veterinary services and technical expertise. The Bill & Melinda Gates Foundation/DFID is specifically looking at the dairy food chain to identify foodborne biological hazards, assess post-harvest

practices and risk factors, and increase food safety and food microbiology laboratory capacity in the country. On the other hand, STDF is working with the meat sector value chain to facilitate the export of sheep, goat, and cattle meat to the Middle East and North Africa.

Creation of dedicated food safety centers for training and connectivity. EC's HealthyFoodAfrica ($7.8M, 2020–2024) is creating "Food Systems Labs" in Ethiopia, Uganda, and Kenya as well as Ghana, Benin, and Zambia. Each of 10 localized, context-specific labs (used in the broader sense of experimental settings) will bring researchers, practitioners, and policymakers together to focus on experimentation and innovation in parts of local food systems, including food safety. The approach is founded on interdisciplinary, multi-actor, adaptive co-management, engaging farmers (including smallholders, aquafarmers, SMEs, women, and youth), food processors/packagers, retailers (including street vendors), consumers, NGOs, scientists, decision-makers, and policymakers. The labs will serve as a deliberative space for scientific experts, practitioners, and government to establish lasting relationships and together tackle locally relevant food system challenges, including consumer awareness, local food diversity, improved post-harvest technologies, and food safety.

FAO is investing in food safety education through universities in Tanzania, Uganda, South Sudan, Burundi, and Rwanda (budget not available).

Promotion of incentives for food safety in informal markets. In Tanzania, FAO has continued its work on Healthy Street Food Incentives, which aim to make street food safer as well as more nutritionally balanced and profitable. Similarly, the Bill & Melinda Gates Foundation/DFID is funding a project to incentivize food safety in urban food markets using a "pull-push approach." The project tests the hypothesis that consumer demand can provide an impetus for food safety (pull). In order to facilitate change, an enabling environment and the food safety capacity among market-level value chain actors are also strengthened (push).

Analysis of risk: Building the food safety evidence base. The Bill & Melinda Gates Foundation/DFID has invested more than $7.7M in two recent projects intended to build the evidence base regarding risk and the burden of foodborne disease. In Ethiopia, a project called The Assessment and Management of Risk from Non-Typhoidal *Salmonella*, Diarrheagenic *Escherichia coli* and *Campylobacter* in Raw Beef and Dairy in Ethiopia (TARTARE) is developing and implementing a risk-based framework for food safety management and resource allocation, with a focus on non-typhoidal *Salmonella* spp., diarrheagenic *E. coli,* and *Campylobacter* spp. in raw beef and dairy, as Ethiopia has a cultural tradition of eating raw beef. A second project, Foodborne Disease Epidemiology, Surveillance and Control in African LMIC (FOCAL) is investigating the burden of FBD in four African LMICs (including Tanzania and

Ethiopia) by combining different methodologies (e.g., population surveys, metagenomics analyses of sewage, literature review, and analysis of available health-care surveillance data).

Another project in Tanzania, funded by the U.S. DTRA, was designed to gather evidence about a poorly understood food safety problem—the role of bushmeat in the transmission of six pathogens between animals and humans. An interdisciplinary and multi-institutional team is mapping the distribution of anthrax, Ebola, Marburg, and monkeypox viruses as well as *Brucella* spp. and *Coxiella burnetti*. The team will then assess the biological risk and potential for impact on human health from these diseases.

Technical capacity building. Two recent food safety projects are expanding food safety capacity building and technical assistance, a continuation of work done in earlier years. The USDA has invested in capacity building for governmental institutions and other organizations including NGOs, cooperatives, and the private sector in the areas of animal health, food safety, and AMR. The initiative has a value chain approach with the overall objective to reduce poverty and strengthen the resilience of smallholder farmers in the EAC. Along the same lines, Sweden offers its International Training Programmes to food testing laboratory personnel in order to close gaps in the assessment of food safety. The developed curriculum covers all aspects of the food safety system, from the understanding of food safety systems to sample collection, recordkeeping, and troubleshooting. It consists of online and face-to-face training modules with lectures, breakout sessions, and hands-on laboratory exercises.

3.6 Lessons learned from the food safety project outcomes in East Africa

Project evaluation design. Publicly available information on the evaluation design of projects was scarce. However, based on available descriptions and indicators, most projects seemed to fall into the bucket of "before and after." Randomized controlled trials were uncommon. They are complicated to design, expensive to run, and require ethical considerations. The United Kingdom did have one randomized controlled trial looking at aflatoxin and child stunting, which was almost halted due to concern about the known exposure of the control group to high levels of aflatoxins.

Impact based on scientific evidence. Nearly all of the projects that introduced an intervention with direct and measurable hazard reduction were focused on aflatoxin. Some of these projects investigated and/or promoted new food safety technologies and thus were expected to show scientific evidence of effectiveness.

For example, the IITA scientists behind Aflasafe, a biocontrol product designed to decrease aflatoxin-producing *Aspergillus flavus* in food crops, recently published 10 years of results from two years of efficacy trials required for registration, the large-scale trials used to demonstrate product value (another two years), and commercial use by thousands of maize farmers (six years). Nearly 95% of more than 7,000 grain samples, each representing 30-ton grain lots from treated fields, had less than 10 ppb of aflatoxins. Although these results were limited to the Nigeria experience, researchers are planning to publish more studies soon reporting efficacy in East Africa (Kenya and Tanzania). In October 2019, a factory for Aflasafe KE01™ was launched by Kenya's Ministry of Agriculture (KALRO) in association with IITA.

A second large aflatoxin project, AflaSTOP, was also grounded in a detailed research methodology. This joint investment by the Bill & Melinda Gates Foundation and USAID focused on the development of low-cost grain drying and storage technology for aflatoxin prevention. Rigorous testing of multiple devices was performed in order to identify the commercially viable small-scale storage and drying technologies most suitable for smallholder farmers. Samples obtained from storage devices were analyzed over six months for aflatoxin, fumonisin, moisture content, insect count, and damage and discoloration. For their on-farm research, AflaSTOP created a paired t-test design (each farming family in one treatment was paired with a similar farming family in the other treatment).

Projects conducted by the McKnight Foundation and the USAID Feed the Future Innovation Lab for Peanut (University of Georgia) appeared to combine lab studies with some field research in order to determine the scientific effectiveness of aflatoxin interventions.

Other research projects may have generated evidence but stopped short of implementing and evaluating the impact of new interventions. For example, the Hazards Associated with Zoonotic enteric pathogens in Emerging Livestock meat pathways (HAZEL) project, funded through UK Research and Innovation (UKRI), applied leading food safety research methods to Tanzania's food system through a modular process risk model approach. This project, along with Safe Food, Fair Food, was one of the few food safety research investments aimed at addressing the presence of microbiological hazards such as *Salmonella* spp. and *Campylobacter* spp. in livestock meat (ruminants and poultry). A blend of social science, microbiological, and modeling techniques was used to describe meat pathways from poor farmers through abattoirs to meat retailers. Knowledge gaps on microbiological hazards were identified, described qualitatively, and ultimately quantified using microbiological risk assessment. In all, the Zoonoses Laboratory in Tanzania tested more than 950 samples from cattle, more than 600 samples from goats, 226 samples from meat processing environments, and more than 850 samples from poultry farms over the course of the project. Whole genome sequencing and antimicrobial susceptibility

testing were also conducted on positive samples. At the conclusion of the project, it was not yet clear whether the non-typhoidal *Salmonella* detected posed an actual health risk, although follow-up work with human health surveillance systems was planned. Although the HAZEL project yielded a large amount of evidence on hazards in ASF, investigators urged caution in data interpretation, especially within the policy context, to avoid potential unintended socioeconomic consequences on certain value chain actors.

In general, development donors did not appear to hold an expectation that projects demonstrate direct impacts through measurable hazard reductions in foods or decreases in foodborne illness incidence. Rather, project indicators were often publicly reported in terms of frequencies: number of training sessions and participants, policies created, lab tests performed and/or data generated, products exported, and physical infrastructure completed. Surveys were sometimes used to assess food safety knowledge, attitudes, and practices. However, these more indirect methodologies, combined with gaps in surveillance/testing, problems with long-term uptake and compliance, and the vast complexity of East Africa food systems, make it extremely challenging to verify food safety project success.

***Examples of other critical success factors in East Africa food safety projects*.** Based on participant interviews and author experience, project efficacy was maximized by some East Africa projects in the GFSP database by using the following:

- Participatory needs assessments before planning interventions
- A multidisciplinary approach (such as One Health)
- Coordinated efforts to achieve systemic change (beyond fragmented and scattered responses by different players, with overlapping and potentially competitive activities)
- Evaluation of drivers of food safety compliance and the economic viability of compliance
- Planning in flexibility to respond to changes in the balance of need and new food safety challenges when they arise
- Adapting country quotas to their needs and offering sustained training missions
- Addressing incentives and behavior change motivation
- Structured dissemination plans at the national level and clearly presented guidelines on information dissemination
- Informing value chain participants of the project, since “women are known to carry out the major tasks in farming and to prepare food for their families” (Kangethe, 2014)

Table 7. Subjective assessment of food safety investments in East Africa "Intervention" matrix. This table contains numbers to represent the total East Africa food safety projects from 2010 to 2017. The table reflects projects in which these value chain participants were involved and not necessarily the level of intervention. Interventions widely used in food safety but not found in the study are added as text.

Sector	Farmers/ Fishermen	Processors/ Transporters	Retailers	Consumers	Government	Total*
Food safety technologies	1	1	0	0	1	1
Training	21	11	5	6	27	37
Information	18	12	6	11	19	27
New processes	23	13	5	11	23	39
Organizational arrangements	8	7	3	3	5	9
Regulation	11	9	3	4	19	23
Infrastructure	9	8	2	4	9	12

**Total number of projects with these elements (some projects may touch on more than one)*

Based on the data above (Table 7), key areas where there appears to be underinvestment in the East Africa region in relation to the relative importance to food safety include:

- Food safety technology for processing/transport
- Training for retailers and consumers
- Information for retailers, including risk assessment, disease surveillance, and public awareness campaigns
- Organizational arrangements (all value chain stakeholders), including certification and compliance for export and private audits and certifications
- Infrastructure (all value chain stakeholders), including processing facilities and equipment as well as laboratory facilities and equipment

4.0 Discussion and Concluding Recommendations

The following study limitations are acknowledged:

- No resource (budget) information was available for 16 of the 59 projects. Project-level budgets were not accessible for WHO, and some of these projects were in-kind donations of staff expertise, which is not taken into account.
- Because donors were allowed to self-report some budget estimates, financial information is approximate and potentially inaccurate.
- Report estimates include some African national government cost-sharing contributions (e.g., for STDF, development banks, Codex Trust Fund), but these generally make up 5% or less of the project's funding.
- Within projects operating in multiple countries, it was not always possible to quantify resource amounts allocated to the work in a single country. For this reason, some of the project budgets include work in countries outside the East Africa region.
- Because data collection was completed in mid-2017, projects implemented in 2017 are underrepresented in the analysis. Thus, the last year for extrapolating investment trends over time is 2016. Projects implemented from mid-2017 on are not included in the database for analysis; however, a summary of 16 projects is included.
- Evaluation: Although donors or implementers might have performed monitoring and evaluation on food safety investments, this information was not commonly available to the public. As a result, it was not possible to use monitoring and evaluation reports as a standard basis for project evaluation. Additionally, performance measures were not uniform, making it difficult to compare the success of different projects.
- Since the focus of the mapping project was on international aid, research grants were not surveyed as heavily as development and public health interventions. As a result, research work might be underrepresented.

4.1 Alignment of investments with country needs

Of the seven countries, Uganda was the only one for which a food safety assessment could be identified (FAO 2014). However, the sections below contain basic information on the diets for each country, as well as the major foods and hazards targeted by past investments (in the GFSP database) and the estimated burden of specific foodborne hazards. (Due to the scarcity of surveillance and attribution data, country-specific information on burden should be interpreted with care.) Taking past food safety investments into account, the area(s) of highest intervention potential are discussed for each country.

Uganda. The Ugandan diet primarily consists of plantains, starchy roots such as cassava and sweet potatoes, and cereals (maize, millet, sorghum). Pulses, nuts, and green leafy vegetables complement the diet. Eating patterns are changing in urban areas, with rice increasing in importance (FAO, 2010).

In 2014, an FAO multi-criteria food safety decision-making tool piloted in Uganda examined enteric, parasitic, and chemical hazards, and source attribution (FAO, 2014). It included a detailed situation analysis that described the context for food safety (e.g., legislation, regulatory authorities, the food supply, production, and consumption). Hazard data were collated from surveillance sources (particularly the Health Management Information System administered by the Ministry of Health, and the Central Public Health Laboratory). Using the FAO tool, food safety problems were identified, assessed, and ranked according to immediate illness, long-term health sequelae, and deaths. It was concluded that the following should be addressed as priorities:

- Acute diarrhea, especially in children (multiple hazards)
- Brucellosis in milk products
- Aflatoxin in maize
- Cysticercosis in pork

All of the priority food-hazard pairings were addressed by Ugandan food safety projects in the GFSP database; however, investments in aflatoxin mitigation (particularly in maize) predominated (Table 8). Cysticercosis from *T. solium,* the pork tapeworm, received very little targeted investment, even though it is thought to contribute a significant health burden (11,020 DALYs, second only to non-typhoidal *Salmonella*). Cysticercosis control interventions, such as improved animal husbandry and sanitation, vaccine development, screening assays, and raising consumer awareness, have the potential to make a large difference in Ugandan food safety and should be considered for future investments.

Table 8. Food and hazard information for Uganda

Foods targeted by projects in Uganda[1]	Grains (maize)	Legumes (groundnut)	ASF (milk, meat, seafood)
Hazards targeted by projects in Uganda[2]	aflatoxin	aflatoxin	microbiological (parasites, enteric pathogens including AMR bacteria), chemical (antibiotic residues)
Burden in Uganda[3]	• invasive non-typhoidal *Salmonella* = 27,076 DALYs • cysticercosis = 11,020 DALYs • acute hepatitis A = 5,406 DALYs • liver cancer (other causes) = 5,016 DALYs • other intestinal infectious diseases = 2,027 DALYs • food-borne trematodiases = 0 DALYs		

[1] Other foods: coffee, fruits (avocado, banana, guava, mango, passionfruit, pineapple, oranges), vegetables, chilies
[2] Other hazards: pesticides
[3] IMHE: GBD 2017 (http://ghdx.healthdata.org/gbd-results-tool?params=gbd-api-2017-public/01105956a044a4c834ad34ae28646ac3)

Kenya. Donors' large food safety investment in aflatoxin mitigation reflects the risks thought to be associated with maize used in traditional diets (Table 9). The burden of nonspecific liver cancer in Kenya is estimated at nearly 5,000 DALYs (Maiyoh & Tuei, 2019); however, sufficient/reliable evidence does not exist on this and other pathologies potentially related to aflatoxin.

Like other countries in East Africa, Kenya has recently been undergoing a nutritional transition characterized by a departure from diets rich in grain, fruits, and vegetables to a more meat-based "western diet" (Republic of Kenya Ministry of Health, 2017). Evidence has shown that microbiological foodborne hazards, particularly in ASF, have a significant impact on consumer health. In Kenya, invasive non-typhoidal *Salmonella* alone is estimated to account for 176,829 DALYs (in relation to investments to reduce their impact). Similarly, cysticercosis caused by *T. solium* in contaminated pork is a significant source of disease in Kenya (estimated at 9,545 DALYs) but has not been a major focus of investment.

Table 9. Food and hazard information for Kenya

Foods targeted by projects in Kenya[1]	Grains (maize)	ASF (meat [beef, chicken, pork], milk, seafood)	Legumes (groundnut, peas, beans)
Hazards targeted by projects in Kenya [2]	aflatoxin, fumonisin	Microbiological: bacteria (*Listeria, Vibrio, Campylobacter, Salmonella, Bacillus*), parasites (*Taenia solium, Toxoplasma gondii, Paragonimus*), antibiotic residues, aflatoxin, fumonisin in milk	aflatoxin, fumonisin
Burden in Kenya[3]	• invasive non-typhoidal *Salmonella* = 176,829 DALYs (103,381- 285,558) • acute hepatitis A = 9,611 DALYs • cysticercosis = 9,545 DALYs • liver cancer (other causes) = 4,844 DALYs • other intestinal infectious diseases = 1,310 DALYs • food-borne trematodiases = 0 DALYs		

[1] *Other foods: legumes (peas, beans, groundnut), vegetables, fruits (passion fruit, orange, banana, guava, mango, pineapple, avocado)*
[2] *Other hazards: pesticides*
[3] *IMHE: GBD 2017 (http://ghdx.healthdata.org/gbd-results-tool?params=gbd-api-2017-public/01105956a044a4c834ad34ae28646ac3)*

Tanzania. Diets vary considerably among Tanzania's geographical regions. Maize dominates diets in the surplus-maize-producing regions of the Southern Highlands. Households in these northern regions still consume maize but favor other sources of starch such as cassava and banana (Cochrane & D'Souza, 2015). On average, maize makes up approximately 41% of the calories in a typical diet of mainland Tanzania. In Dar es Salaam, households tend to consume a more diverse diet than in the other regions. Hazards of importance are listed below (Table 10).

Table 10. Food and hazard information for Tanzania

Foods targeted by projects in Tanzania[1]	Grains (maize)	ASF (meat [beef/ruminants, chicken], milk, seafood)	Legumes (groundnut)
Hazards targeted by projects in Tanzania[2]	aflatoxin	Microbiological: *E. coli, Salmonella, Taenia solium, Toxoplasma* spp., *Listeria, Vibrio, Campylobacter, Bacillus, Paragonimus;* antibiotic residues	aflatoxin
Burden in Tanzania[3]	• invasive non-typhoidal *Salmonella* = 34,922 DALYs • acute hepatitis A = 15,501 DALYs • cysticercosis = 9,545 DALYs • liver cancer (other causes) = 6,094 DALYs • other intestinal infectious diseases = 4,302 DALYs • food-borne trematodiases = 0 DALYs		

[1] *Other foods: fruits (tomato, avocado, banana, guava, mango, passionfruit, pineapple), vegetables, cassava, cashew*
[2] *Other hazards: pesticides*
[3] *IMHE: GBD 2017 (http://ghdx.healthdata.org/gbd-results-tool?params=gbd-api-2017-public/01105956a044a4c834ad34ae28646ac3)*

Ethiopia. Consumption of fruits and vegetables is particularly low in Ethiopia. Only 34% of women reported having consumed any vegetable or fruit the previous day. Intake of quality protein is limited. Despite the traditional use of a large variety of legumes, consumption of beans and peas was reported by only 18% of women, and only 0.17% reported consuming seeds and nuts (EPHI, 2013). Only 1.2% of women consumed eggs, 1.5% flesh foods, and 17% dairy. Foodborne pathogens such as *Salmonella* spp. and *Escherichia coli* are a public health problem and common causes of illness and death. The latest Demographic and Health Survey reported that 12% of children under five in Ethiopia experienced diarrhea, but the extent to which this burden of disease is attributed to foodborne pathogens is unknown (CSA & ICF, 2016). Concern about aflatoxin contamination, particularly in milk, maize, and certain legumes, is also increasing. However, only a limited number of studies on food safety are available, and none are national, large-scale studies, nor is there a comprehensive surveillance system

(Abayneh, Nolkes, & Asrade, 2014; Gebru et al., 2018). Projects have targeted multiple hazards (Table 11).

Table 11. Food and hazard information for Ethiopia

Foods targeted by projects in Ethiopia[1]	ASF (milk, meat, seafood)	Legumes (groundnut)	Grains (maize, sorghum)
Hazards targeted by projects in Ethiopia[2]	microbiological (bacteria: *Listeria, Vibrio, Bifidobacterium, Campylobacter, Salmonella, Bacillus,* enteric pathogens, including AMR pathogens), parasites (*Taenia solium, Toxoplasma gondii, Paragonimus*), antibiotic residues	aflatoxin	mycotoxins (aflatoxin)
Burden in Ethiopia[3]	• Cysticercosis = 16,221 DALYs • acute hepatitis A = 16,162 DALYs • liver cancer (other causes) = 6,765 DALYs • other intestinal infectious diseases = 6,363 DALYs • invasive non-typhoidal *Salmonella* = 5,066 DALYs • food-borne trematodiases = 0 DALYs		

[1] *Other foods: fruits (tomato), vegetables, coffee*
[2] *Other hazards: pesticides*
[3] *IMHE: GBD 2017 (http://ghdx.healthdata.org/gbd-results-tool?params=gbd-api-2017-public/01105956a044a4c834ad34ae28646ac3)*

Rwanda. Investments have targeted grains, especially maize, groundnuts, and cassava (Table 12). Mycotoxins have been reported in multiple value chains including animal feeds (Nishimwe et al., 2019); maize (Nishimwe et al., 2017); soybeans (Niyibituronsa et al., 2018); and in cassava (Matsiko et al., 2017). Exposure to aflatoxins can lead to serious health consequences including liver cancer. Pesticide use has been reported in Rwanda (Okonya et al., 2019), and their use in agricultural production can have significant negative effects on the environment and public health (Carvalho 2017). Vegetable contamination with *Listeria* spp., *Salmonella* spp., *Campylobacter* spp., and pathogenic *E. coli* was reported in the study by Ssemanda et al. (2018) (n=198 samples). Important foodborne hazards have also been reported in ASF including milk and meat (Kamana et al., 2014; Ndahetuye et al., 2020).

Table 12. Food and hazard information for Rwanda

Foods targeted by projects in Rwanda[1]	Grains (maize)	Legumes (groundnut)	Vegetable (cassava)
Hazards targeted by projects in Rwanda[2]	aflatoxin	aflatoxin	aflatoxin
Burden in Rwanda[3]	• invasive non-typhoidal *Salmonella* = 8,233 DALYs • cysticercosis = 3,743 DALYs • acute hepatitis A = 2,751 DALYs • liver cancer (other causes) = 1,266 DALYs • other intestinal infectious diseases = 598 DALYs • food-borne trematodiases = 0 DALYs		

[1] Other foods: n/a
[2] Other hazards: enteric pathogens, including AMR pathogens
[3] IMHE: GBD 2017 (http://ghdx.healthdata.org/gbd-results-tool?params=gbd-api-2017-public/01105956a044a4c834ad34ae28646ac3)

Burundi. Investments have sought to address aflatoxins in cereals. Udomkun et al. (2018) reported aflatoxins in multiple products including maize, groundnuts, sorghum, beans, and soybeans. In the same study, aflatoxin M1 levels (in milk) exceeding the EU limit of 50ng/kg were reported. Microbial hazards are also a concern but very little has been documented on their occurrence. Poor hygiene and sanitation are challenges that development partners are working to improve (WHO, 2018; UNICEF, 2019).

Table 13. Food and hazard information for Burundi

Foods targeted by projects in Burundi[1]	Grains (maize)	Legumes (groundnut)	Other
Hazards targeted by projects in Burundi [2]	aflatoxin	aflatoxin	enteric pathogens, including AMR pathogens
Burden in Burundi [3]	• invasive non-typhoidal *Salmonella* = 13,123 DALYs • cysticercosis = 3,605 DALYs • acute hepatitis A = 1,999 DALYs • other intestinal infectious diseases = 1,206 DALYs • liver cancer (other causes) = 1,014 DALYs • food-borne trematodiases = 0 DALYs		

[1] *Other foods: n/a*
[2] *Other hazards: n/a*
[3] *IMHE: GBD 2017 (http://ghdx.healthdata.org/gbd-results-tool?params=gbd-api-2017-public/01105956a044a4c834ad34ae28646ac3)*

South Sudan. South Sudan gained independence in 2011. The country has faced a number of challenges including food insecurity (Dorosh et al., 2015). Investments have targeted grains, especially maize and groundnuts. Cereal production in 2019 was estimated at 818,500 tons (FAO, 2020). The Seed System Security Assessment of Southern Sudan (FAO, 2011) shows sorghum and maize as the main cereal crops grown in the country. There is little published information on the food safety situation in South Sudan. However, cases of foodborne disease outbreaks have been observed, including one case reported by the Ministry of Health in 2018[3]. Meat condemnation and its causes were highlighted in the study by Ochi et al. (2015).

[3] https://www.who.int/hac/crises/ssd/sitreps/south-sudan-suspected-foodborn-disease-24feb2018.pdf

Table 14. Food and hazard information for South Sudan

Foods targeted by projects in South Sudan[1]	Grains (maize)	Legumes (groundnut)	Other
Hazards targeted by projects in South Sudan[2]	aflatoxin	aflatoxin	n/a
Burden in South Sudan[3]	• invasive non-typhoidal *Salmonella* = 17,478 DALYs • cysticercosis = 2,995 DALYs • acute hepatitis A = 2,664 DALYs • other intestinal infectious diseases = 1,950 DALYs • liver cancer (other causes) = 1,333 DALYs • foodborne trematodiases = 0 DALYs		

[1] *Other foods: n/a*
[2] *Other hazards: n/a*

4.2 Other factors influencing past interventions

Investment in aflatoxin over other hazards. Aflatoxins can be addressed with different approaches at both pre-harvest and post-harvest, unlike some of the microbiological hazards that might require more work to establish points where control measures should be applied.

***Absence of investment in parasitic foodborne diseases, such as* T. solium.** Given the burden of cysticercosis in the region, the lack of investment in *T. solium* (pork tapeworm) is notable.

Donor-specific factors. Large donors are influenced by their priorities, mandates, and established relationships.

- EC: Focus on public and private capacity to verify compliance of African food exports with EC safety standards. EC investments in the analysis were completely limited to Kenya, Tanzania, Uganda, and Ethiopia, which export a significant amount of food to European consumers (unlike South Sudan, by contrast).
- United States: Focus on developing value chains and addressing hazards (notably aflatoxins) related to food security and trade in SSA. Kenya, Uganda, and Ethiopia have historically been target countries for USAID's Feed the Future initiative, and they were well represented in U.S. investments.

- FAO: Focus on technical assistance, policy guidance, and other knowledge resources; legislation and standards; and training related to national control systems
- WHO: Focus on health-related policy development, guidance, and training to support national control systems, including risk assessment and the public health aspects of food safety

Increases in investment amounts and project numbers over time. The increased investment in food safety over time is notable. This was likely driven by several factors. One of the most important was the FERG report showing the burden of FBD was of equal magnitude to that of malaria, HIV/AIDs, or tuberculosis—the so-called "big three." Another factor was increasing disillusionment with the theory that African countries could trade their way out of poverty. Instead, as demographic analysis predicted the population of Africa would rise to four billion by 2100, the emphasis shifted to how Africa could feed this population. Other factors likely include urbanization and increased literacy and access to information. Several FBD scandals were widely disseminated, generating concern.

At the same time, evidence on the prevalence of foodborne hazards and the risk of FBD was growing. Much of this was generated by the CGIAR, especially ILRI, through a series of projects funded by the German Federal Ministry of Economic Cooperation and Development, DFID, and others. There was also a stream of publications on the importance of food safety. Aflatoxins were a special case and benefited from strong advocacy. While its health impacts are very low, it is a "dread disease" because of incidences when many people died. Moreover, it is associated with stunting and is important for trade. IITA was a major player in aflatoxin control, and PACA was an important initiative. Although the current (as of 2020) COVID-19 pandemic is causing enormous economic losses that may be reflected in development investments, it is likely that food safety will continue to rise in the development agenda.

4.3 Recommendations for future investment

Based on the extensive analysis of previous investments, some recommendations for future investment are offered:

- Focus on the burden of domestic FBD rather than export. Economic analysis shows that domestic health impacts are an order of greater magnitude than the costs of trade losses (Jaffee et al., 2018).
- Focus on the foods that the vast majority (especially the poor) eat and the markets where food is bought. This implies greater attention to the informal markets, whether they are traditional fresh food markets, small shops, or street food.

- Focus on the “vital few” and not the “trivial many.” The best evidence suggests a small number of hazards are responsible for most of the health burden (Pareto’s law) (Perry and Grace, 2009). There should be systematic prioritization to identify these.
- Focus on problems amenable to solutions. For example, research has shown that training informal vendors can result in safer food, providing they have an incentive for changing behavior (Kang’ethe et al., 2012; Grace et al., 2012; Lindahl et al., 2018).
- Address legislation and regulation, which is rarely implemented and sometimes more of a burden than a benefit.
- Simplify food safety governance, which is often distributed over multiple agencies and poorly coordinated.
- Better engage the private sector (both formal and informal) in all initiatives to improve commitment to food safety.
- Help the private sector develop a culture of food safety and increase trust among all actors by facilitating communication, traceability, and testing.
- Invest in infrastructure such as rural roads, electricity, and cold chains to improve food safety and reduce waste.
- Explore mechanisms whereby consumer demand for safe food can be used to motivate value chain actors to improve food safety.
- Raise awareness at every level (farmers, transporters, processors, retailers, consumers, policymakers, investors) on the problem of FBD and solutions.

5.0 References

Abayneh, E., Nolkes, D., & Asrade, B. (2014). Review on common foodborne pathogens in Ethiopia. *African Journal of Microbiology Research*, *8*(53), 4027-4040. https://doi.org/10.5897/AJMR2014.7015

Aiyar, A., Pingali, P. (2020). Pandemics and food system – towards a proactive food safety approach to disease prevention and management. *Food Sec*. 12, 749-756. http://doi.org/10.1007/s12571-020-01074-3

Bandyopadhyay, R., Atehnkeng, J., Ortega-Beltran, A., Akande, A., Falade, TDO, Cotty, PJ. (2019). "Ground-truthing" efficacy of biological control for aflatoxin mitigation in farmers' fields in Nigeria: from field trials to commercial usage, a 10-year study. *Front Microbiol*, 10, 2528. https://doi:10.3389/fmicb.2019.02528.

Carvalho, F. P. (2017). Pesticides, environment, and food safety. In Food and Energy Security (Vol. 6, Issue 2, pp. 48–60). Wiley-Blackwell Publishing Ltd. https://doi.org/10.1002/fes3.108.

Cochrane, N., & D'Souza, A. (2015). *Measuring Access to Food in Tanzania: A Food Basket Approach,* EIB-135, U.S. Department of Agriculture, Economic Research Service. https://www.ers.usda.gov/amber-waves/2015/march/measuring-access-to-food-in-tanzania-a-food-basket-approach

Central Statistical Agency (CSA) Ethiopia and ICF. (2016). *Ethiopia Demographic and Health Survey 2016.* Addis Ababa, Ethiopia, and Rockville, Maryland, USA. https://dhsprogram.com/publications/publication-fr328-dhs-final-reports.cfm

Dobson, A. P., Pimm, S. L., Hannah, L., Kaufman, L., Ahumada, J. A., Ando., A. W., Bernstein, A., Busch, Daszak, P., Engelmann, J., Kinnaird, M. F., Binbin, V. L, Loch-Temzelides, T., Lovejoy, T., Nowak, K., Roehrdanz, P. R., Vale, M. M. (2020). Ecology and economics for pandemic prevention. *Science.* 24 v. 369, pp 379-381. DOI: 10.1126/science.abc3189

Dorosh, P. A., Rashid, S., Childs, A., & van Asselt, J. (2015). Enhancing Food Security in South Sudan: The Role of Public Food Stocks and Cereal Imports. In International Food Policy Research Institute Discussion Paper. https://ebrary.ifpri.org/digital/api/collection/p15738coll2/id/129824/download.

East African Community (EAC). (2018). *Food and Nutrition Security Strategy 2018-2022.* https://health.eac.int/publications/eac-food-and-nutrition-security-strategy-2018-2022#gsc.tab=0

EPHI. (2013). *Ethiopia National Food Consumption Survey Report*. Ethiopian Public Health Institute, Addis Ababa.

https://www.ephi.gov.et/images/pictures/National%20Food%20Consumption%20Survey%20Report_Ethiopia.pdf

Food and Agriculture Organization of the United Nations. (2010). *Nutrition country profiles: Uganda.* http://www.fao.org/ag/agn/nutrition/uga_en.stm

Food and Agriculture Organization of the United Nations. (2011). Seed System Security Assessment South Sudan. http://www.fao.org/3/ba0032e/ba0032e00.pdf.

Food and Agriculture Organization of the United Nations and World Health Organization. (2012). *Activities of FAO and WHO Complementary to the Work of the Codex Alimentarius Commission.* http://www.fao.org/tempref/codex/Meetings/CCAFRICA/ccafrica20/ca20_04_add1e.pdf

Food and Agriculture Organization of the United Nations. (2014). *Testing multi-criteria approaches for food safety decision making*. http://www.fao.org/3/a-bc265e.pdf

Food and Agriculture Organization of the United Nations. (2019). *The Future of Food Safety: First FAO/WHO/AU International Food Safety Conference.* http://www.fao.org/3/CA3247EN/ca3247en.pdf

Food and Agriculture Organization of the United Nations. (2020). FAO GIEWS Country Brief on South Sudan. http://www.fao.org/giews/countrybrief/country.jsp?code=SSD

Food and Agriculture Organization of the United Nations. (n.d.) *This document supports CX/CAC 11/34/15 and describes FAO and WHO capacity development activities since the 34th Session of the CAC.* http://www.fao.org/fileadmin/user_upload/agns/pdf/FAOWHOcapacitybuildingCAC35.pdf

Gebru, M., Remans, R., Brouwer, I., Baye, K., Melesse, M.B., Covic, N., Habtamu, F., Abay, A.H., Hailu, T., Hirvonen, K., Kassaye, T., Kennedy, G., Lachat, C., Lemma, F., McDermott, J., Minten, B., Moges, T., Reta, F., Tadesse, E., Taye, T. (2018). *Food systems for healthier diets in Ethiopia: toward a research agenda*. https://a4nh.cgiar.org/files/2018/04/DP1050_Formatted.pdf

Gibb, H.J., Barchowsky, A., Bellinger, D., Bolger, P.M., Carrington, C., Havelaar, A.H., Oberoi, S., Zang, Y., O'Leary, K. and Devleesschauwer, B. (2019). Estimates of the 2015 global and regional disease burden from four foodborne metals – arsenic, cadmium, lead and methylmercury. *Environmental Research*, 174, 188–194. https://doi.org/10.1016/j.envres.2018.12.062

GBD 2017 Non-Typhoidal Salmonella Invasive Disease Collaborators. 2019. The global burden of non-typhoidal salmonella invasive disease: a systematic analysis for the Global Burden of Disease Study 2017. Lancet Infect Dis 2019; 19: 1312–24. https://doi.org/10.1016/ S1473-3099(19)30418-9

Global Food Safety Partnership. (2018). *Food safety in Africa: past endeavors and future directions*. https://www.gfsp.org/sites/gfsp/files/public/GFSP%20Report_Food%20Safety%20in%20Africa-web.pdf

Grace, D., Mahuku, G., Hoffmann, V. et al. (2015). International agricultural research to reduce food risks: Case studies on aflatoxins. *Food Security* 7, 569–582. https://doi.org/10.1007/s12571-015-0469-2

Grace, D., Alonso, S., Mutua, F., Roesel, K., Lindahl, J. and Amenu, K. (2018). Food safety investment expert advice: Burkina Faso, Ethiopia, Nigeria. Nairobi, Kenya: ILRI. https://www.ilri.org/publications/food-safety-investment-expert-advice-burkina-faso-ethiopia-nigeria

Grace, D., Dipeolu, M., Olawoye, J., Ojo, E., Odebode, S., Agbaje, M., Akindana, G., & Randolph, T. (2012). Evaluating a group-based intervention to improve the safety of meat in Bodija Market, Ibadan, Nigeria. Tropical Animal Health and Production, 44(S1), 61–66. https://doi.org/10.1007/s11250-012-0208-z

Havelaar, A., Kirk, M., Torgerson, P., Gibb, H., Hald, T., Lake, R., Praet, N., Bellinger, D., De Silva, N., Gargouri, N. and Speybroeck, N. (2015). World Health Organization global estimates and regional comparisons of the burden of foodborne disease in 2010. *PLOS Medicine*, 12(12). https://doi.org/10.1371/journal.pmed.1001923

Jaffee, S.; Henson, S.; Unnevehr, L.; Grace, D.; Cassou, E. (2019). *The Safe Food Imperative: Accelerating Progress in Low- and Middle-Income Countries. Agriculture and Food Series.* Washington, DC: World Bank. https://openknowledge.worldbank.org/handle/10986/30568

Kamana, O., Ceuppens, S., Jacxsens, L., Kimonyo, A., & Uyttendaele, M. (2014). Microbiological quality and safety assessment of the Rwandan milk and dairy chain. Journal of Food Protection, 77(2), 299–307. https://doi.org/10.4315/0362-028X.JFP-13-230

Kangethe, E. (2014). Comprehension and action required for successful aflatoxin control. FoodAfrica. https://portal.mtt.fi/portal/page/portal/mtt_en/projects/foodafrica/news/Comprehension%20and%20action%20required%20for%20successful%20aflatoxin%20control

Kang'ethe, E., Kimani, V., Grace, D., Mitoko, G., McDermott, B., Ambia, J., Nyongesa, C., Mbugua, G., Ogara, W., & Obutu, P. (2012). Development and delivery of evidence-based messages to reduce the risk of zoonoses in Nairobi, Kenya. Tropical Animal Health and Production, 44(SUPPL.1), 41–46. https://doi.org/10.1007/s11250-012-0205-2

Lindahl, J. F., Deka, R. P., Melin, D., Berg, A., Lundén, H., Lapar, M. L., Asse, R., & Grace, D. (2018). An inclusive and participatory approach to changing policies and practices for improved milk safety in Assam, northeast India. In Global Food Security (Vol. 17, pp. 9–13). Elsevier B.V. https://doi.org/10.1016/j.gfs.2018.03.002

Maiyoh, G.K., & Tuei, V.C. (2019). Rising cancer incidence and role of the evolving diet in Kenya. *Nutrition and Cancer,* 71(4), 531-546. https://doi.org/10.1080/01635581.2018.1542010

Matsiko, F., Kanyange, C., Ingabire, G., Dusingizimana, T., Vasanthakaalam, H. and Kimonyo, A. (2017). Detection and quantification of aflatoxin in cassava and maize flour sold in Kigali open markets, Rwanda. International Food Research Journal, 24(1), 459–464. http://www.ifrj.upm.edu.my/24%20(01)%202017/(61).pdf

Ndahetuye, J. B., Artursson, K., Båge, R., Ingabire, A., Karege, C., Djangwani, J., Nyman, A. K., Ongol, M. P., Tukei, M., & Persson, Y. (2020). MILK Symposium review: Microbiological quality and safety of milk from farm to milk collection centers in Rwanda. *Journal of Dairy Science* 103(11): 9730–9739. https://doi.org/10.3168/jds.2020-18302

Nishimwe, K., Wanjuki, I., Karangwa, C., Darnell, R., & Harvey, J. (2017). An initial characterization of aflatoxin B1 contamination of maize sold in the principal retail markets of Kigali, Rwanda. Food Control, 73, 574–580. https://doi.org/10.1016/j.foodcont.2016.09.006

Nishimwe, K., Bowers, E., Ayabagabo, J. de D., Habimana, R., Mutiga, S., & Maier, D. (2019). Assessment of Aflatoxin and Fumonisin Contamination and Associated Risk Factors in Feed and Feed Ingredients in Rwanda. Toxins, 11(5), 270. https://doi.org/10.3390/toxins11050270

Niyibituronsa, M., Onyango, A., Gaidashova, S., Imathiu, S., Uwizerwa, M., Wanjuki, I., Nganga, F., Muhutu, J. C., Birungi, J., Ghimire, S., Raes, K., De Boevre, M., De Saeger, S., & Harvey, J. (2018). Evaluation of mycotoxin content in soybean (*Glycine max* L.) grown in Rwanda. African Journal of Food, Agriculture, Nutrition and Development, 18(3), 13808–13824. https://doi.org/10.18697/AJFAND.83.17710

Ochi, E., Simplisio, E., Ismail, A., & Lukaw, Y. (2015). A Retrospective Study on the Major Causes of Meat Condemnations in Animals Slaughtered in Juba County South Sudan. International Journal of Bioassays, 4(12), 4620–4624. https://www.ijbio.com/abstract/a-

retrospective-study-on-the-major-causes-of-meat-condemnations-in-animals-slaughtered-in-juba-county-south-sudan-14202.html

Okonya, J. S., Petsakos, A., Suarez, V., Nduwayezu, A., Kantungeko, D., Blomme, G., Legg, J., & Kroschel, J. (2019). Pesticide use practices in root, tuber, and banana crops by smallholder farmers in Rwanda and Burundi. International Journal of Environmental Research and Public Health, 16(3). https://doi.org/10.3390/ijerph16030400

Perry, B., & Grace, D. (2009). The impacts of livestock diseases and their control on growth and development processes that are pro-poor. In Philosophical Transactions of the Royal Society B: Biological Sciences (Vol. 364, Issue 1530, pp. 2643–2655). Royal Society. https://doi.org/10.1098/rstb.2009.0097

Republic of Kenya Ministry of Health. (2017). *National Guidelines for Healthy Diets and Physical Activity.* http://nak.or.ke/wp-content/uploads/2017/12/NATIONAL-GUIDELINES-FOR-HEALTHY-DIETS-AND-PHYSICAL-ACTIVITY-2017-NEW-EDIT.pdf

Ssemanda, J., Reij, M., van Middendorp, G., Bouw, E., van der Plaats, R., Franz, E., Muvunyi, C., Bagabe, M., Zwietering, M., & Joosten, H. (2018). Foodborne pathogens and their risk exposure factors associated with farm vegetables in Rwanda. *Food Control*, 89, 86–96. https://doi.org/10.1016/j.foodcont.2017.12.034

Udomkun, P., Mutegi, C., Wossen, T., Atehnkeng, J., Nabahungu, N. L., Njukwe, E., Vanlauwe, B., & Bandyopadhyay, R. (2018). Occurrence of aflatoxin in agricultural produce from local markets in Burundi and Eastern Democratic Republic of Congo. Food Science and Nutrition, 6(8), 2227–2238. https://doi.org/10.1002/fsn3.787

UNICEF. (2019). Water, sanitation and hygiene | UNICEF Burundi. https://www.unicef.org/burundi/water-sanitation-and-hygiene

World Health Organization. (2015). WHO estimates of the global burden of foodborne diseases: Foodborne disease burden epidemiology reference group 2007-2015. https://www.who.int/foodsafety/foodborne_disease/ferg/en/

World Health Organization. (2018). UN-Water Global Analysis and Assessment of Sanitation and Drinking-Water. https://www.who.int/water_sanitation_health/monitoring/investments/country-highlights-2017/burundi-glaas2017-country-highlight-181015.pdf?ua=1

World Trade Organization. (2015). *Technical assistance to developing countries.* https://docs.wto.org/dol2fe/Pages/FE_Search/FE_S_S009-DP.aspx?language=E&CatalogueIdList=135006&CurrentCatalogueIdIndex=0&FullTextHash=1&HasEnglishRecord=True&HasFrenchRecord=True&HasSpanishRecord=True

6.0 Appendices

Appendix A. List of 2010–2017 projects

Year began	Year ended	Donor	Project	Project summary
2008	2011	Germany	Safe Food, Fair Food I - Safe food, fair food: Building capacity to improve the safety of ASF foods and ensure continued market access for poor farmers in SSA.	To support the intensification of livestock production by improving the quality management of livestock products – responds to the concern that small-scale producers will be prevented from marketing their products as standards are skyrocketing. The strategy adopted is adapting risk-based approaches that are the gold standard for food safety management in developed countries. A number of studies on participatory risk analysis were carried out in eastern, southern, and western Africa, and national workshops were held to engage policymakers to raise awareness about the potential food safety hazards that exist along the entire value chain.
2009	2013	WHO	Project: Support to review the training modules on foodborne disease surveillance, to evaluate the analytical capacities of food control laboratories, and elaboration of procedural manual/methodological guides	Support to review the training modules on FBD surveillance and to conduct an evaluation of the analytical capacities of food control laboratories and elaboration of procedural manual/methodological guides

2010	2013	Canada	Compliance with Private Food Safety Standards Among Smallholders in Kenya	GLOBALG.A.P. is one of the private food safety standards that Kenyan horticultural farmers have to adopt to remain in export production. The project evaluated the drivers of producer GLOBALG.A.P. compliance over different institutional arrangements (such as financing mechanisms), the economic viability of compliance, and the livelihood impact of compliance. In addition, the project aimed to build the capacity of farmers and other locally based actors to enhance compliance and thereby contribute to increased welfare in the project area.
2010	2016	EC	EDES – Strengthening Food Safety Systems through SPS measures – Ethiopia, Uganda, Tanzania, and Kenya	To contribute to poverty alleviation through the integration of food products from African, Caribbean, and Pacific regions into international, and particularly European, trade flows through risk-based food safety systems.
2010	2013	Finland	Safe Food, Safe Dairy Phase 1	Building capacity to improve safety in the dairy and maize value chains with respect to health risks associated with mycotoxin contamination.
2010	2012	EC	Better Training for Safe Food in Africa: Establishing a reference framework on food hygiene, regional workshops	Regional workshops to support improvements to national and regional animal health and food safety legal frameworks.

2010	2012	McKnight Foundation	Groundnut variety improvement for yield and adaptation, human health, and nutrition. Includes breeding for low aflatoxin and field management practices	To address productivity constraints by further varietal development leading to the release of new disease-resistant varieties with tolerance to drought and resistance to colonization by the fungus (*Aspergillus*) that produces aflatoxin.
2010	2012	FAO	Improving Food Safety in Meat Value Chains in Kenya	Value chain analyses for beef and chicken to describe activities required to bring meat products from production to consumption. Identification of key regulations by national authorities; stakeholder interviews on food safety regulation, surveillance, monitoring, and enforcement; a pilot study in Nairobi to identify supply chain characteristics impacting food safety; surveillance for non-typhoidal *Salmonella*, *Campylobacter*, and AMR along product pathways; questionnaires to farmers; discussions with the private sector; workshops with policymakers and food chain actors.
2010	2011	FAO/WHO	Evaluation of food safety programs and food control systems for the development of policies and national strategic plans	Evaluation of food safety programs and food control systems for the development of policies and national strategic plans.
2010	2016	FAO	Supporting national programs of food safety in Tanzania	“Training of trainers” courses on internationally recognized, Codex-based systems of food safety and quality (group training, one-on-one coaching and mentoring, and ongoing distance support). Six phases.

2011	2016	FAO	Multi-year training of food safety trainers	United Nations Development Assistance Plan on Economic Growth under which a multi-year program for training of food safety trainers was implemented.
2011	2013	Bill & Melinda Gates Foundation, United States, United Kingdom	Development and commercialization of biological control of aflatoxins in Kenya and Nigeria	Development of Aflasafe KE01™ (in Kenya) and Aflasafe Nigeria. Collect baseline data on the incidence of aflatoxin in Kenya and Nigeria; enable commercialization and availability of Aflasafe for maize and groundnut in Nigeria; enhance the capacity of Kenyan institutions to conduct biocontrol research; create awareness, train farmers and strengthen stakeholder capacity for aflatoxin management in Nigeria and Kenya; conduct field testing with maize and groundnut; construction of a new, modern laboratory facility; construction of a small-scale plant that will manufacture Aflasafe KE01™.
2011	2013	Australia	Capacity and action for aflatoxin reduction in Eastern Africa	Establishing a regional nutritional analytical platform and applying it to reduce aflatoxin contamination of Kenyan and Tanzanian maize and other grains.
2011	2016	Japan	Strengthening of Agricultural Pesticide Residue Analysis System	Assists the Ethiopian Ministry of Agriculture by providing capacity building of the Quality Monitoring and Pesticide Testing Laboratory to monitor pesticide levels on selected priority crops and to implement pesticide residue analytical methods that can be applied to other agricultural commodities.
2011	2016	Bill & Melinda Gates Foundation, United Kingdom, United States	PACA	To develop an Africa-based and Africa-led partnership, and to substantially control aflatoxin contamination in key staple crops across SSA.

2011	2015	Australia	Developing a mycotoxin diagnostics platform	Developing a mycotoxin diagnostics platform and applying this to a national maize-breeding program.
2011	2015	United States	Mycotoxin Contamination in Tanzania: Quantifying the problem in maize and cassava, within Africa Research in Sustainable Intensification for the Next Generation	To quantify mycotoxin contamination levels on maize and cassava in Tanzania and provide an objective basis for commissioning interventions to dramatically improve health and livelihoods and increase the income of rural households. Specifically, to quantify key mycotoxins among toxic microbial metabolites in maize and cassava in rural households and markets; to sensitize stakeholders in Tanzania about the occurrence of key mycotoxins, allowing targeted mycotoxin mitigation strategies; and to establish a prevalence database that can guide mycotoxin risk assessment and risk mapping activities in the country and hence strengthen standards and regulation mechanisms.
2011	2016	WHO	Five Keys to Safer Food (including integration into WHO Growth Chart)	Integrate food safety matters into education and information programs for consumers. Five Keys to Safer Food messages (keep clean; separate raw and cooked foods; cook thoroughly; keep food at safe temperatures; and use safe water and raw materials) incorporated in the new WHO Growth Chart.
2011	2014	WHO	National food safety policies	Support for finalization or drafting of national food safety policies.
2012	2015	FAO	Evidence-informed decision making for national food safety policy	Pilot project using multi-criteria approaches for food safety decision making, including social, trade, economic, and food security impacts.

2012	2014	McKnight Foundation	Innovative Communication Media and Methods for More Effective Aflatoxin Mitigation in Groundnut (ICMM)	To assess the role of communication in influencing the process of change that leads from awareness to understanding and to desirable, sustainable action to reduce aflatoxin exposure in these countries. The project used an informal Learning Alliance Approach and also tested the effectiveness of leaflets, radio, and video in increasing awareness and understanding of aflatoxin mitigation and management.
2012	2014	FAO	Codex Trust Fund	Assessing types and levels of mycotoxin contamination in sorghum in Burkina Faso, Ethiopia, Mali, Sudan.
2012	2015	Germany	Safe Food, Fair Food II: Risk-based approaches to improving food safety and market access in smallholder meat, milk, and fish value chains in four African countries	To support the intensification of livestock production by improving the quality management of livestock products. Used an action research approach for stakeholder engagement at the regional level toward uptake of tools and approaches to enhance food safety in informal markets in Africa.
2012	2017	United Kingdom	Study on aflatoxin and child stunting links	To lead research on the link between aflatoxin exposure and child nutrition through a randomized controlled trial in Kenya on the impact of an intervention aimed at lowering consumption of aflatoxin-contaminated grain on growth in childhood.
2012	2016	Finland	My Dairy Kenya (Food Africa WP5): Measuring and mitigating the risk of mycotoxins in maize and dairy products for poor consumers in Kenya	To strengthen capacity at local and national levels for assessing and mitigating mycotoxins in milk and maize; to improve food safety and human and animal health by reducing mycotoxin contamination in staple crops and dairy products in Kenya; to improve market access of the poor in SSA through improved post-harvest technologies.

2012	2017	United States	Long-term training (2014–2017) within the Feed the Future Innovation Lab for Collaborative Research on Peanut Productivity and Mycotoxin Control	Comparison of storage systems for in-shell, shelled, and blanched peanuts; effects of applications of calcium to reduce aflatoxin contamination in peanut; determining the utility of drying methods, including fabricating a solar dryer to reduce aflatoxin contamination in peanuts; evaluation of interventions to reduce aflatoxin; effect of rotations and harvest date on preharvest aflatoxin contamination; residual aflatoxin in oil from contaminated peanuts.
2013	2014	United States	Mycotoxin contamination in Rwanda (Aflasafe): Quantifying the problem	Proper quantification of mycotoxin contamination to provide an objective basis for risk assessment of key mycotoxins, which in turn will help in identifying target areas for intervention; harmonization of mycotoxin standards for enhancing trade in the region; stimulation of local monitoring/surveillance and enforcement mechanisms, thereby ensuring that the staples consumed locally are safe; and for commissioning interventions to dramatically improve health and livelihoods and increase the income of rural households.
2013	2016	FAO	Support for the Dissemination of Pre-and Post-Harvest Technologies for Management of Aflatoxin Contamination of Maize in Kenya for Improved Health and Income	Develop a coordination framework for the prevention of aflatoxin contamination. Enhance the technical capacity of selected officers in aflatoxin contamination strategies for both national and county governments. Develop a monitoring system of aflatoxin control and management. Develop a national code of practice for aflatoxin prevention.
2013	2017	WTO	African Pesticide Residue Data Generation Project	Enhance regional capacity in pesticide residues data generation and monitoring for establishing, implementing, and complying with international pesticide residues standards.

2013	2016	United States, Bill & Melinda Gates Foundation	AflaSTOP Post Harvest Storage Structures	Identifies the most promising dryers and storage options that will impede the growth of fungi-producing aflatoxin and ensure that these dryers and storage options are accessible to smallholder farmers through African businesses. The cativity was co-funded by the Bill & Melinda Gates Foundation as a Global Development Alliance partnership, with the foundation matching the USAID contribution by a factor of at least 1:1.
2013	2016	United States	Aflatoxin Policy and Program for East African Region (APPEAR) (Aflasafe)	Provide a comprehensive package of training, technical assistance, and pilot operational research activities relevant and/or required to the EAC health, agriculture, trade, and environment units, and member state principals responsible for policy and program design, dissemination, and implementation.
2014	2017	United States	Mycotoxin Detection Option, within the Feed the Future Innovation Lab for Collaborative Research on Peanut Productivity and Mycotoxin Control	A systematic comparative study to evaluate and report existing/emerging analytical methods for aflatoxin determination in peanuts and peanut products.
2014	2016	FAO	Technical Cooperation Programme	Strengthening national food control systems.
2014	2016	FAO	Support to capacity building	Support to capacity building for Codex Alimentarius and improved food control systems in Eastern African countries.

2014	2017	United States	RNAi Silencing of Aflatoxin Synthesis, within the Feed the Future Innovation Lab for Collaborative Research on Peanut Productivity and Mycotoxin Control	To use RNA interference (RNAi) to reduce aflatoxin contamination of peanut seeds. Analyze samples from Ethiopia, Kenya, Malawi, Uganda, Zambia, and the United States and fingerprint using sequences within the aflatoxin synthesis gene cluster. Conduct hands-on training of African scientists at the National Peanut Research Laboratory.
2014	2017	Finland	Safe Food, Safe Dairy Phase 2	Building capacity to improve safety in the dairy and maize value chains with respect to health risks associated with mycotoxin contamination.
2014	2018	McKnight Foundation	New varieties and management systems to improve productivity, food security, and safety as well as market competitiveness	To tackle aflatoxin contamination through variety release, promotion, and improvement of nutritional quality. Sustainable intensification approaches were used to increase productivity, stabilize yields, and provide agro-ecological services. Strengthening management of aflatoxin through better diagnosis and training. More than 300,000 households were targeted.
2014	2018	WTO	Breaking barriers, facilitating trade	Increase intra-COMESA (Common Market for Eastern and Southern Africa) trade in agri-food products by reducing trading costs associated with SPS measures for selected commodities on selected trade routes.
2014	2016	Sweden	Food Safety Capacity Building: Quality Infrastructure for Food Safety and Trade	Training program that aimed to provide the experience and the knowledge on how to develop, maintain, and, in practice, work with national systems for food safety and trade in food.

2014	2017	United Kingdom	HAZEL Africa	To assess the microbiological hazards for human health in emerging systems of livestock meat production, processing, distribution, and consumption in Tanzania; to develop a robust understanding of how zoonotic enteric pathogens flow through the meat chain in Tanzania, and to use this information to develop policies to improve food safety. The approach involved a mixture of social and biological science, including field and laboratory activities and modular process risk model. Capacity building for Ministry of Livestock and Fisheries Development and leading Tanzanian veterinary, agricultural, and human health academic institutions.
2014	2016	WHO	Technical assistance in the review of national malnutrition/food hygiene protocols	Technical assistance in the review of national protocols on the management of acute malnutrition and/or strategy for the prevention of chronic malnutrition and integration of food hygiene.
2015	2016	France	Technical assistance	Feasibility study of the future abattoirs of Addis Ababa (AAAE).
2015	n/a	WHO	Foodborne disease surveillance and AMR (pilots)	Pilot initiatives on foodborne disease surveillance and AMR.
2015	2017	United States	Marketing Food Safety in Kenya, Global Center for Food Safety Innovation (GCFSI)	To introduce certified aflatoxin-safe maize flour to the Kenyan market and provide coordination between farmers, traders, millers, and consumers.

2016	2017	Sweden	Animal Health and Food Safety Capacity Building	Capacity building for governmental institutions and other organizations including NGOs, cooperatives, and the private sector in the areas of food safety, animal health, and AMR. Value chain approach with the overall objective to reduce poverty and strengthen the resilience of smallholder farmers in the EAC.
2016	2021	Alliance for Accelerating Excellence in Science in Africa (AESA)	Afrique One-ASPIRE: Foodborne diseases and nutritional illness thematic training program	Addresses the epidemiological links between food and human health, including infectious and non-infectious diseases, and shows how these factors will influence the effectiveness of control interventions based on risk. Research activities included "Senegal: the implementation of hygiene practices increases the economic profitability of dibiteries."
2016	2018	Denmark	Improved Food Safety, Quality, and Value Addition in the Dairy and Horticulture Sector	To build capacity in food safety, improved quality, value addition, and capacity building in the dairy and horticulture sectors with an emphasis on control of residues and certain contaminants.
2016	2020	Bill & Melinda Gates Foundation	PACA II	To generate an evidence base on the prevalence of aflatoxin in Africa, disseminate knowledge about tools and strategies to combat aflatoxins, and engage with public and private sector stakeholders to increase an aflatoxin-free food supply.
2016	2020	United States, Bill & Melinda Gates Foundation	ATTC	Identify strategic options for partnership with private companies or government entities, execute those partnerships, and help ensure Aflasafe products reach millions of farmers.

2016	2019	United Kingdom	Addressing Antimicrobial Resistance	To strengthen national/regional policies, capacities, and systems for the detection, monitoring, regulation, and management of AMR risks in the poultry, beef, and pig value chains. Whole food chain study to assess and quantify microbial contamination and AMR pathogens.
2016	2018	McKnight Foundation	Research on push-pull, a novel cropping system utilizing two companion plants that have the potential to provide Striga, stem borer, and aflatoxin control.	To investigate the co-relation of stem borer attacks and maize companion plants on aflatoxin in the soil.
2017	2018	FAO	Review and analysis of food fraud and economically motivated adulteration in Uganda	To make available low-cost devices and methods for food authorities to use directly in the streets and markets, building on the opportunities created by advances in field-deployable analytical equipment. The project will initially focus on devising methods to quickly analyze milk powder and vegetable oil, two commodities that are particularly vulnerable to adulteration.
2017	2019	FAO	Aflatoxin mitigation response	Aflatoxin mitigation response through the dissemination of appropriate postharvest management technologies and awareness-raising in the Dodoma and Manyara regions.
2017	2018	Finland	My Dairy II Kenya (Food Africa WP5): Measuring and mitigating the risk of mycotoxins in maize and dairy products for poor consumers in Kenya	To strengthen capacity at the local and national levels for assessing and mitigating mycotoxins in milk and maize; to improve food safety and human and animal health by reducing mycotoxin contamination in staple crops and dairy products in Kenya; to improve market access of the poor in SSA through improved post-harvest technologies.

2017	2023	GAFSP, AfDB	Aflatoxin Control in Maize and Groundnut Value Chains	To support efforts to improve food safety and security by minimizing the occurrence of aflatoxin in the maize and groundnut food chains.
n/a	2016	WHO	Research on enteric pathogens	Research on enteric pathogens from human, animal, and food sources, including AMR.

Appendix B. List of collaborators, by country

Collaborators in Kenyan Projects	
Academic/ Research	***Within Kenya*** African Agricultural Technology Foundation (AATF) Dairy Research Institute Egerton University International Livestock Research Institute (ILRI) Jomo Kenyatta University of Agriculture and Technology Kenya Agricultural & Livestock Research Organization (KALRO) Kenya Agricultural Research Institute (KARI) University of Nairobi (UoN) ***Outside Kenya*** Addis Ababa University, Ethiopia Centre Suisse de Recherches Scientifiques en Cote d'Ivoire (CSRS), Cote d'Ivoire Ecole Inter Etats des Sciences et Médécine Vétérinaires de Dakar (EISMV), Senegal International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) International Food Policy Research Institute (IFPRI) Kilimanjaro Clinical Research Institute –Kilimanjaro Christian Medical Centre (KCRI-KCMC), Tanzania Kwame Nkrumah University of Science and Technology (KNUST), Ghana Lilongwe University of Agriculture and Natural Resources (LUANAR), Malawi Makerere University, Uganda Mikocheni Agricultural Research Institute (MARI), Tanzania Muhimbili University of Health and Allied Sciences (MUHAS), Tanzania National Crops Resources Research Institute (NaCRRI), Uganda National Veterinary Research Institute (INIVE), Mozambique Nelson Mandela African Institution of Science and Technology (NM-AIST), Tanzania Open University of Tanzania (OUT) Sokoine University of Agriculture (SUA), Tanzania Tanzania Wildlife Research Institute (TAWIRI), Tanzania

	University of Dar es Salaam (UDSM), Tanzania University of Ghana University of Pretoria/HarvestChoice, South Africa University of Zambia, Lusaka ***Outside Africa*** Auburn University, United States Cornell University, United States École Nationale des Services Vétérinaires, France Free University of Berlin (FUB), Germany German Institute for Risk Assessment (BfR) National Food Institute, Technical University, Denmark Rakuno Gakuen University, Japan Texas A&M University, United States Western Michigan University, United States
Private Sector	Small-scale farmers and producers, agribusiness extension workers, farmer-based organizations, processors, food distributors, and their professional associations, food business operators Agrochemicals Association of Kenya (AAK) Eastern African Grain Council (EAGC) Fresh Produce Exporters Association of Kenya (FPEAK) Promotion of Private Sector Development in Agriculture (PSDA)
Civil Society	Caritas Meru Pesticides and Agricultural Resource Centre (PARC)
Government	Horticultural Crops Development Authority (HCDA) Kenya Agricultural Research Institute (KARI) Kenya Bureau of Standards (KEBS) Kenya Dairy Board Kenya Medical Research Institute (KEMRI) Kenya Plant Health Inspectorate Service (KEPHIS)

	Ministry of Agriculture, Livestock, and Fisheries Ministry of Health, Republic of Kenya Ministry of Public Health and Sanitation, Directorate of Veterinary Services National Food Safety Coordination Committee (NFSCC) Pest Control Products Board (PCPB)
Other	African Academy of Sciences (AAS) African Union Commission (AUC) Agricultural Cooperative Development International (ACDI)/Volunteers in Overseas Cooperative Assistance (VOCA) Bill & Melinda Gates Foundation Centre for Agriculture and Bioscience International (CABI) Common Market for Eastern and Southern Africa (COMESA) Danish Veterinary and Food Administration (DVFA) East African Community Secretariat European Union/Europe-Africa-Caribbean-Pacific Liaison Committee (COLEACP) Evira (Finland) Finland Food and Agricultural Organization of the United Nations (FAO) Food and Environment Research Agency, United Kingdom France Vétérinaire International French Agricultural Research Centre for International Development (CIRAD) MTT Agrifood Research Finland Natural Resources Institute, United Kingdom Natural Resources Institute Finland (Luke) Partnership for Aflatoxin Control in Africa (PACA) UK Aid United States Agency for International Development (USAID) Kenya Horticultural Competitiveness Program United States Department of Agriculture Agricultural Research Service (USDA ARS) Wellcome Trust World Health Organization (WHO)

Collaborators in Ugandan Projects	
Academic/ Research	***Within Uganda*** Makerere University School of Public Health, Uganda National Agricultural Research Systems (NARS), Uganda National Crops Resources Research Institute (NaCRRI), Uganda WorldFish (Uganda) ***Outside Uganda*** Addis Ababa University, Ethiopia Centre Suisse de Recherches Scientifiques en Cote d'Ivoire (CSRS), Cote d'Ivoire Chitedze Mycotoxin Laboratory, Malawi Jomo Kenyatta University of Agriculture and Technology, Kenya Kwame Nkrumah University of Science and Technology (KNUST), Ghana Lilongwe University of Agriculture and Natural Resources (LUANAR), Malawi National Veterinary Research Institute (INIVE), Mozambique Pesticides and Agricultural Resource Centre (PARC), Kenya Sokoine University of Agriculture (SUA), Tanzania University for Development Studies, Ghana University of Ghana University of Nairobi (UoN), Kenya University of Zambia, Lusaka ***Outside Africa*** Auburn University, United States École Nationale des Services Vétérinaires, France Food and Environment Research Agency, United Kingdom France Vétérinaire International Free University of Berlin (FUB), Germany French Agricultural Research Centre for International Development (CIRAD) German Institute for Risk Assessment (BfR)

	International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) National Food Institute/Technical University, Denmark National Veterinary Research Institute of Mozambique (INIVE) Natural Resources Institute, United Kingdom *(CSRS)* Rakuno Gakuen University, Japan
Private Sector	Producers, processors, food distributors/traders and exporters, food business operators and their professional associations, pesticide manufacturers Eastern African Grain Council (EAGC) Uganda Manufacturers Association (UMA)
Civil Society	Consumer Education Trust (CONSENT)
Government	Department of Crop Protection Directorate of Government Analytical Laboratory (DGAL) Ministry of Agriculture, Animal Industry and Fisheries, Uganda Ministry of Internal Affairs, Uganda Ministry of Trade Industry and Cooperatives National Codex Committee (NCC) National Drug Authority National Food Safety Advisory Committee Uganda Coffee Development Authority Uganda Export Promotion Board (UEPB) Uganda Fisheries Processors & Exporters Association (UFPEA) Uganda National Bureau of Standards

Other	African Union Commission (AUC) African Union Interafrican Bureau for Animal Resources (AU-IBAR) Agence Francaise de Securite Sanitaire de l'alimentation, de l'alimentation, de l'environnement et du travail (ANSES), France Bill & Melinda Gates Foundation Centre for Agriculture and Bioscience International (CABI) Common Market for Eastern and Southern Africa (COMESA) Department for International Development (DfID), United Kingdom East African Community (EAC) Food and Agricultural Organization of the United Nations (FAO) FAO/WHO Foodborne Epidemiology Reference Group (FERG) International Atomic Energy Agency (IAEA) Perishable Agricultural Commodities Act (PACA) United States Agency for International Development (USAID) United States Department of Agriculture Agricultural Research Service (USDA ARS) World Health Organization (WHO) Advisory Group on Integrated Surveillance of Antimicrobial Resistance (AGISAR) World Health Organization (WHO) Global Foodborne Infections Network (GFN) European Union Germany

Collaborators in Ethiopian Projects	
Academic/ Research	***Within Ethiopia*** Addis Ababa University Center for Food Science and Nutrition, Addis Ababa University ***Outside Ethiopia*** Centre Suisse de Recherches Scientifiques en Côte d'Ivoire (CSRS), Côte d'Ivoire Jomo Kenyatta University of Agriculture and Technology, Kenya Makerere University, Uganda National Agricultural Research Systems (NARS), Uganda National Crops Resources Research Institute (NaCRRI), Uganda National Veterinary Research Institute (INIVE), Mozambique Pesticides and Agricultural Resource Centre (PARC), Kenya Sokoine University of Agriculture (SUA), Tanzania University of Ghana University of Nairobi, Kenya WorldFish, Uganda ***Outside Africa*** Andhra Pradesh Human Resource Development Institute (APHRDI), India Auburn University, United States École Nationale des Services Vétérinaires, France Food and Environment Research Agency, United Kingdom Free University of Berlin (FUB), Germany French Agricultural Research Centre for International Development (CIRAD) German Institute for Risk Assessment (BfR) International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) National Food Institute/Technical University, Denmark Natural Resources Institute, United Kingdom

	Rakuno Gakuen University, Japan
Private Sector	Producers, processors, food distributors/traders and exporters, food business operators and their professional associations, pesticide manufacturers Ethiopian Horticulture Producer Exporters Association (EHPEA)
Civil Society	n/a
Government	Ethiopian Food and Drug Administration (EFDA) Food, Medicine and Health Care Administration and Control Authority (FMHACA) Ministry of Agriculture Quality Monitoring and Pesticide Testing Laboratory (QMPTL)
Other	Agence Francaise de Securite Sanitaire de l'alimentation, de l'alimentation, de l'environnement et du travail (ANSES), France Direction générale de l'alimentation (DGAL), France East African Community Secretariat France Vétérinaire International United States Department of Agriculture Agricultural Research Service (USDA ARS) National Peanut Research Laboratory (NPRL) World Health Organization (WHO)

Collaborators in Rwandan Projects	
Academic/ Research	***Within Rwanda*** Centre for Geographic Information Systems and Remote Sensing Center at the National University of Rwanda (CGIS-NUR) ***Outside Rwanda*** n/a ***Outside Africa*** IFA-Tulln, Austria University of Natural Resources and Applied Life Sciences, Vienna, Austria
Private Sector	Smallholder farmers Eastern African Grain Council (EAGC)
Civil Society	n/a
Government	Rwanda Agriculture Board (RAB) Rwanda Standards Board (RSB)
Other	Bill & Melinda Gates Foundation Partnership for Aflatoxin Control in Africa (PACA) United States Department of Agriculture (USDA) World Health Organization (WHO)

Collaborators in Burundi Projects	
Academic/ Research	***Within Burundi*** n/a ***Outside Burundi*** n/a ***Outside Africa*** n/a
Private Sector	n/a
Civil Society	n/a
Government	Government of Burundi
Other	East African Community (EAC) World Health Organization (WHO)

Collaborators in South Sudan Projects	
Academic/ Research	***Within South Sudan*** n/a ***Outside South Sudan*** n/a ***Outside Africa*** n/a
Private Sector	n/a
Civil Society	n/a
Government	Government of South Sudan
Other	East African Community (EAC) United States Department of Agriculture Agricultural Research Service (USDA ARS)

Appendix C. List of food safety officials, by country (current for Nov. 2020)

Kenya

Name	Title	Organization
Ayore, Nicholas Otieno	Head, Public Health	Directorate of Veterinary Services, State Department of Livestock
Kilonzo, Robert	Head, Food Safety and Quality	Ministry of Public Health and Sanitation
Kinyua, Julia	Senior Deputy Director of Veterinary Services	Directorate of Veterinary Services, State Department of Livestock
Kituto Kitele, Musyoki	Senior Compliance Officer	Kenya Dairy Board
Mwirigi, Martin	Research Scientist	Kenya Agricultural & Livestock Research Organization (KALRO)
Namu, Lucy		Kenya Plant Health Inspectorate Service (KEPHIS)
Ngeroge, Phillip	Head of Trade	Trade & Standards Coordination Office, KEPHIS
Omondi Mugenya, Isaac	Laboratory Analyst - Food and Agriculture Laboratory	Kenya Bureau of Standards (KEBS)
Onyango, Alice	Manager	Kenya National Codex Secretariat, KEBS
Osoro, Doreen	Assistant Laboratory Analyst	KEBS

Tanzania

Name	Title	Organization
Iwodyah, Mohamed		Tanzania Food & Drugs Authority (TFDA)
Shekilango, Salama	Quality Assurance Officer	Tanzania Bureau of Standards (TBS)

Uganda

Name	Title	Organization
Julius, Wandera	Senior Laboratory Technician	Dairy Development Authority (DDA)
Kasirye-Alemu, Eve	Executive Director	Uganda National Bureau of Standards (UNBS)

Kuchana Kateu, Kepher	Director	Government Analytical Laboratory
Nakibuuka, Mary Magdalein	Senior Analyst	UNBS
Onen, Geoffrey	Lead Chemist	Government Analytical Laboratory
Rubakuba, Jean	Quality Assurance Manager	Uganda Industrial Research Institute

Ethiopia

Name	Title	Organization
Abdurahman, Mr.		Import and Export Goods Quality Control Directorate, Ministry of Trade
Abebe Melaku, Fikru	Food Industries Support Expert	Ministry of Trade and Industry
Admas, Abebaw	Food Fortification Expert	Ministry of Trade and Industry
Araya, Daniel	Expert	Ministry of Trade and Industry
Asmare, Getachew		Ministry of Agriculture and Livestock Resources
Bayle, Zemene		Ethiopian Standards Agency (ISO)
Bekele, Meseret		Veterinary Public Health Directorate, Livestock Sector, Ministry of Agriculture
Bizuwork, Hanna	Beverage Industries Support Team Leader	Ministry of Trade and Industry
Chemeda Beyene, Dandena	Director	Ministry of Trade and Industry
Chernet Atamirie, Nigus	Food Industries Study, Support and Follow up Team Leader	Ministry of Trade and Industry
Geberegiorgis, Mr.		Import and Export Goods Quality Control Directorate, Ministry of Trade
Grba, Heran	Director General	Food, Medicine, Healthcare and Control Authority

Hailemichael, Mr.		Food Registration and Licensing Directorate, Food, Medicine and Health Care Administration and Control Authority (FMHACA)
Jima, Ermias	Food Industries Support Senior Expert	Ministry of Trade and Industry
Kiflu, Bitsu	VPH/Food Safety Expert	Ministry of Agriculture
Weres, Haileselassie	Director General	Ethiopian Meat and Dairy Industry Development Institute (EMDIDI)

Rwanda

Name	Title	Organization
Mutezinka, Honorine	Pesticide & Veterinary Drug Residues Laboratories Officer	Rwanda Standards Board
Wiclef Kagisha, Theogene	Director of Chemical Laboratories Unit	Rwanda Standards Board

Burundi

Name	Title	Organization
Cimpaye, Felix		Burundi Bureau of Standards & Quality Control
Ndikuriyo, Pascal		National Centre of Food Technology
Pélagie, Nimbona	Analyst	National Centre for Food Technology (CNTA)

South Sudan

None available

Appendix D. East Africa food safety investments since 2017 (not comprehensive)

Country/ countries	Donor	Title	Summary	Years	Budget (USD)
Ethiopia	Bill & Melinda Gates Foundation, DFID	The Assessment and Management of Risk from Non-Typhoidal *Salmonella*, Diarrheagenic *Escherichia coli,* and *Campylobacter* in Raw Beef and Dairy in Ethiopia dairy in Ethiopia (TARTARE)	To efficiently and sustainably reduce foodborne disease mortality and morbidity by developing and implementing a risk-based framework for food safety management and resource allocation in low- and middle-income countries.	2018–2022	3,391,062
Ethiopia, Burkina Faso	Bill & Melinda Gates Foundation, DFID	Urban food markets in Africa: Incentivizing food safety using a pull-push approach	To reduce the burden of foodborne disease in Ethiopia and Burkina Faso by building the capacity of food chain actors and regulators to cost-effectively mitigate important food safety risks in the poultry and vegetable value chains.	2018–2022	3,541,047
Ethiopia	Bill & Melinda Gates Foundation, DFID	Ensuring safety and quality of milk and dairy products across the dairy value chain in Ethiopia	To identify the prevalence and distribution of foodborne biological hazards associated with milk and dairy products (highly nutritious food items). Assess post-harvest practices and risk factors regarding milk and dairy product handling across the dairy value chain in Ethiopia. Increase the food safety and food microbiology laboratory capacity of dairy value chain actors and government stakeholders through trainings.	2018–2022	998,227

Tanzania, Ethiopia, Mozambique, Nigeria	Bill & Melinda Gates Foundation, DFID	Foodborne Disease Epidemiology, Surveillance, and Control in African LMIC (FOCAL)	To investigate the burden of FBD in four African low- and middle-income countries by combining different methodologies including population surveys, metagenomics analyses of sewage, literature review, and analysis of available healthcare surveillance data.	2018–2022	3,387,108
EAC	EC, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)	EAC Market Access Upgrade Programme (MARKUP)	Improving sector standards and harmonization of SPS measures. The project supports national partners to address market access constraints, as well as the EAC Secretariat, to coordinate selected region-wide policy and regulatory capacities.	2018–2023	44,249,790
Ethiopia	EC	Health of Ethiopian Animals for Rural Development (HEARD)	Strengthening and optimizing the quality of public and private veterinary services; improving technical competencies and incentives for veterinary service providers; building capacity for food safety of primary products of animal origin and for control of zoonotic diseases.	2018–2022	17,017,350

Rwanda	EC	Technical assistance	To support the National Agricultural Export Development Board's capacity to upgrade the specialized export quality infrastructures to the international standards. This will include the export laboratories, which will serve the export sub-sector, not only for monitoring compliance but also for planning and preventing any deviation with regards to the market requirements.	2018–2020	333,904
Ghana, Benin, Ethiopia, Uganda, Kenya, Zambia	EC	HealthyFoodAfrica	Includes five thematic work packages for holistically addressing food system challenges (nutrition and consumption; sustainable production; postharvest; food safety; value chain governance; novel products and processes).	2020–2024	7,847,200
Tanzania	FAO	Advancing Healthy Street Food Incentives to boost the safety and nutritional balance of street food in sub-Saharan Africa (TCP/RAF/3611)	Aims at making street food in SSA safer, more nutritionally balanced, and more profitable, contributing to the health and livelihoods of the population in the region, as well as contributing to the achievement of sustainable development goals.	2017–2019	n/a

Tanzania, Uganda, South Sudan, Burundi, Rwanda	FAO	Food safety education in East Africa and the Caribbean	Build food safety workforce capacity, leading to enhanced food safety, income, and livelihood opportunities. Aims to create strategic partnerships with universities in Tanzania, Uganda, South Sudan, Burundi, and Rwanda in East Africa, and the University of Guyana and the University of the West Indies in 17 English-speaking nations across the Caribbean. It will then evaluate and identify the specific educational and cultural needs of the two regions and create a bespoke targeted undergraduate curriculum to meet them.	Ongoing	n/a

Ethiopia	STDF	Improving Sanitary Capacity to Facilitate Livestock and Meat Exports	Build capacity of Ethiopia's competent authority to meet the SPS requirements of potential and existing importing countries (mainly in the Middle East and North Africa) for export of sheep, goat, and cattle meat; and improve coordination and linkages among the various meat sector value chain actors. The project will work with stakeholders identified in different stages of the meat value chain and support them in implementing good SPS-related practices, improving capacity to prevent zoonotic disease, and control food safety hazards.	2018–2021	875,020
Uganda	STDF	Enhancing the capacity of the fruit and vegetable sector to comply with phytosanitary requirements for export to global markets	To improve market access to the European Union as well as other high-end and regional markets for Ugandan fresh fruits and vegetables. Its key purpose is to improve Uganda’s compliance with international phytosanitary standards for the production and export of fresh fruits and vegetables.	2019–2022	882,726

Ethiopia, Kenya, Malawi, Rwanda, Uganda	STDF	Mainstreaming SPS Investments into the Comprehensive Africa Agriculture Development Programme and Other Frameworks	To help selected member states of Common Market for Eastern and Southern Africa (COMESA) to use an evidence-based approach to prioritize SPS investments for market access; mainstream SPS investments within national/regional agricultural, environment, and trade investment plans; and thereby mobilize additional resources for SPS capacity development.	2018–2021	502,425
Burundi, Kenya, Rwanda, Tanzania, Uganda, Zambia	Sweden	International Training Programme – Animal Health and Food Safety	Capacity building for governmental institutions and other organizations including NGOs, cooperatives, and private sector in the areas of animal health, food safety, and AMR. The initiative has a value chain approach with the overall objective to reduce poverty and strengthen the resilience of smallholder farmers in the Eastern African Community.	2017–2021	3,220,940

Ethiopia, Uganda, Mozambique, Rwanda, Kenya, Namibia, Zambia, Malawi	USDA	Food Safety Training	Strives to close gaps in the assessment of food safety in food testing laboratories in East and Southern Africa by providing training services to food testing laboratory personnel. The curriculum covers all aspects of the food safety system, from the understanding of food safety systems to sample collection, recordkeeping, and troubleshooting. It consists of online and face-to-face training modules with lectures, breakout sessions, and hands-on laboratory exercises.	n/a	n/a
Tanzania	U.S. DTRA	Investigating the role of bushmeat in the transmission of zoonotic diseases in Tanzania	To investigate the role of bushmeat in the transmission of six pathogens between animals and humans in Tanzania. An interdisciplinary and multi-institutional team of scientists from Tanzania, Kenya, and the United States are using state-of-the-art techniques to map the distribution of anthrax, Ebola, Marburg, and monkeypox viruses as well as Brucella and Coxiella in bushmeat in Tanzania. The team assesses the biological risk and potential for impact on human health from these diseases. The Biosciences eastern and central Africa (BecA)-ILRI Hub provides capacity building, expertise, and technology for the microbiome component of the project using the genomics platform.	2016–2018	n/a