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The COVID-19 pandemic and its implications for food safety in East Africa



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The COVID-19 pandemic and its implications for food safety in East Africa

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Abstract

Coronavirus disease (COVID-19) is caused by the severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) virus. It was first reported in Wuhan, China (with suspected transmission from a wet market) but has since spread to become a global challenge. The measures put in place to contain the spread of the disease have affected several aspects of the food value chain including safety. Although the virus is not transmitted through food, poor hygiene and sanitation can enhance its spread. We designed a study to explore how response to COVID-19, especially the implementation of mitigation measures, might have impacted on food safety in East Africa. The work was implemented in the framework of an ongoing food safety project in East Africa that was being led by the International Livestock Research Institute (ILRI). Data were collected in November and December 2020 through telephone and online interviews and using a short guide developed by the project. Food safety experts (n = 25) based in countries within East Africa and who had engaged with ILRI in previous projects were asked to participate in the study. In terms of impact, livestock was ranked as the most affected value chain (60%; 15/25), followed by vegetables and fruits (32%) and finally fish (8%). For livestock products, meat (62%), dairy (38%) and poultry (12%) were the most affected by the pandemic. The cereals value chain was perceived to be the least affected (68%). As regards to regulation, staff were few and had to work in shifts. Market surveillance programs were also affected. Food safety concerns associated with bulk purchases (aflatoxins, access to expired products etc.) were reported. Gaps in the implementation of the One Health approach were observed. COVID-19 has significantly impacted food systems, not only in terms of production and access but also in terms of quality and safety of available food products. Interventions to address future pandemics will need to consider the negative impacts arising from enforcement of measures to mitigate diseases of public health importance. A One Health approach would facilitate this.

Key words: COVID-19; SARS-CoV-2 virus; food safety; East Africa

Introduction

Countries are doing their best to ensure they meet regional and international development targets, including the Malabo Declaration (under the aegis of the African Union), on accelerated agricultural growth and transformation, by 2025 (African Union 2014) and the Sustainable Development Goals, led by the United Nations, by 2030 (FAO 2015; Morton et al. 2017). Several factors are reducing progress on human health goals, key being climate change, population growth, urbanization and intensification of agricultural production, all of which have the potential to contribute to emergence or re-emergence of public health threats. It has been estimated that 61% of human infections are zoonotic and over 70% of the emerging ones originate from wild animals (Taylor et al. 2001; Jones et al. 2008). Activities that increase contact with animals have created opportunities for new pathogens to jump and establish themselves in the human population. There are several behaviours that facilitate this, for example, visits to markets that not only sell food but also live animals, hunting and engaging in intensive livestock production activities (Magouras et al. 2020). While these are driven by the need to satisfy the growing demand for food, and for income, caution is needed to reduce disease transmission. Wet markets are a source of food and provide livelihoods for many people (Aiyar and Pingali 2020). The failure to meet food safety standards has provided opportunities for these markets to become hot spots for new viruses to spill over to the human population and ease transmission of diseases (Aguirre et al. 2020; Aiyar and Pingali 2020).

Coronavirus disease (COVID-19) is caused by the severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) virus. It was first reported in Wuhan, China, with spillover linked to a wet market (Chen et al. 2020); it was subsequently detected in Italy, then the United States of America, Brazil (Dhama et al. 2020), and eventually spread to most parts of the world. The peak of the first wave in Africa was in July 2020 and as at 31 December 2020, 2,763,421 cases had been reported from the 55 African Union member states (Salyer et al. 2020). Investigations on the exact cause of COVID-19 are ongoing; however, there are indications that it might have been a spillover from wild animals (likely bats) to the human population. A meta-analysis found fever, cough and muscle soreness to be the main clinical manifestations of the disease (Sun et al. 2020). COVID-19 is transmitted through person-to-person contact and through direct contact with droplets generated when an infected person coughs or sneezes (FAO/WHO 2020b). People infected with the virus will shed it and contaminate the surrounding environment (Shahbaz et al. 2020). Although the virus can survive on surfaces (Boyer and Chapman 2020), this is not believed to be the main transmission route. The stability of the SARS-CoV-2 virus in aerosols and objects has been studied (van Doremalen et al. 2020). It was found that the virus can stay in aerosols for three hours and is more stable on plastic and stainless steel than on copper and cardboard (being detected 72 hours after application). People may become infected by touching contaminated surfaces then touching their own mouth, nose or eyes (FAO/WHO 2020b), the reason why thorough washing of hands with soap and running water, and the use of sanitizers, has been emphasized (Bar 2020). For mitigation, the World Health Organization also advises people to avoid touching their eyes, nose and mouth, and to clean and disinfect surfaces frequently¹.

COVID-19 has disrupted food systems (Barrett 2020) in many different ways. For example, at the peak of the pandemic, food value chains were under pressure to operate but their full potential was hindered by the restrictions imposed, either directly or indirectly. It is the mandate of governments to minimize the disruptions and guarantee the safety of available food products. However, ability to maintain a fully functioning food safety inspection program

was constrained by several factors, among them the reallocation of staff to national COVID-19 emergency response teams, staff working from home and reassigning of food laboratories to COVID-19 clinical testing (FAO/WHO 2020a). The effects of the pandemic are likely to be more serious in the often-forgotten settings and in systems where food is informally traded. Informal food markets characterize food trade in East Africa, provide nutritional and livelihood benefits to communities, and, as observed by Kang'ethe et al. (2020), ensure supply of fresh produce to millions of customers. Foodborne diseases are a global health concern, but they are especially of concern in informal domestic markets, despite weak evidence that they are always less safe than formal market competitors (Grace 2015). Africa, including the subregion (AFR D) where most East African countries lie, is affected much by the burden, having the highest per capita burden (Havelaar et al. 2015). COVID-19 index cases in the region were mainly reported in March 2020, a few months after the outbreak started in China: Kenya – 12 March (Ministry of Health 2020); Tanzania – 12 March (Tarimo and Wu 2020); Ethiopia – 13 March (Baye 2020); Rwanda – 14 March (UNICEF 2020); Uganda – 22 March (Migisha et al. 2020); and South Sudan in April 2020 (Tawad et al. 2020). COVID-19 containment measures were put in place as soon as the first cases were reported.

Although there is currently no evidence that transmission of COVID-19 from one person to another can occur through food, data on the impact the pandemic can have on food systems are needed to support ongoing initiatives to protect livelihoods and guarantee access to safe and nutritious food, now and in the future. We designed a study to explore how the response to COVID-19 might have affected the safety of foods consumed in East Africa. Application of One Health in the mitigation of the pandemic was also assessed.

Methodology

The study was conducted within the framework of a food safety situational analysis in East Africa that was led by the International Livestock Research Institute (ILRI) in 2020. It replaced the planned market observation component that was cancelled due to the COVID-19 pandemic. Data were collected through telephone and online interviews (Skype, Zoom or Microsoft Teams) using a guide developed by the project. Food safety experts based in countries within East Africa and who had participated in a previous food safety workshop organized by ILRI in 2019 were asked to participate in the study. They included experts working in academia and government ministries for the six East African Community member states and Ethiopia. Five to seven participants per country were targeted. We contacted the experts through email and asked them to suggest appropriate times when they would be available for the interviews. A total of 25 experts confirmed their availability; none of the experts from Rwanda was available for the interviews. The survey was designed to capture data on the impact of COVID-19 in the region (although majority of the experts based their responses on what they had observed in their own countries). Interviews were conducted in November and December 2020. They lasted for 30–60 minutes depending on the interview mode used and connection challenges encountered. The findings were synthesized, to reflect the situation in the region, and have been described by themes.

The study was approved by the ILRI Institutional Research Ethics Committee (permit number ILRI-IREC2019-24/2). It was an amendment to the approval granted before the start of the pandemic (ILRI-IREC2019-24). Consent was sought from all the participants before the start of the interviews.

Results

Description of the interviews

A total of 25 interviews were conducted. Kenya and South Sudan were best represented (Table 1). Seven (28%) of the 25 interviewees were females. The interviews were done through mobile phone calls (48%; 12/25), Skype (44%; 11/25), Zoom (4%; 1/25) and Microsoft Teams (4%; 1/25).

Table 1: Number of food safety experts interviewed in the study

Country	Number of experts interviewed (%)
Kenya	7 (28)
South Sudan	6 (24)
Ethiopia	4 (16)
Uganda	4 (16)
Burundi	2 (8)
Tanzania	2 (8)

COVID-19 impact on the livestock value chain

Livestock was ranked as the most affected food value chain (60%; 15/25), followed by vegetables and fruits (32%) and fish (8%). The affected livestock value chains were meat (62%), dairy (38%) and poultry (12%), considering one respondent who was not sure of the answer and two who gave multiple responses. Cereal supply was considered the least affected by the pandemic (68%), followed by fish (23%) and vegetables (14%), excluding three persons who did not respond to the question. One respondent thought vegetables and fish were both least affected. We probed to get justification for these perceptions, especially for the top and the lowest ranked options. First, the rather initial perceived link of the disease with animal food markets was said to have affected consumption of animal-source food products. At the start of the pandemic, restrictions targeted places where people frequently congregate, such as restaurants, roast meat ('nyama choma') eateries and livestock markets, which also affected the cross-border movement of people and animals. As one expert observed: 'We used to see movement from other countries, but this stopped because of the pandemic'.

South Sudan reportedly relies a lot on imports, including those of live animals and milk, which mainly come from Uganda. Chicken meat is also imported from Brazil. Significant changes in the price of chicken meat were reported following the pandemic. The price before and after COVID-19 was reported as 1000 South Sudan pounds (SSP) (approximately 3.3 United States dollars [USD]) and SSP 3000 (~USD 5.4) for beef, SSP 100 (~USD 0.3) and SSP 500 (~USD 0.9) for 500 ml of milk and SSP 40 (~USD 0.13) and SSP 90 (~USD 0.16) for one egg (using a conversion estimate of USD 1 = SSP 300 before COVID-19 and USD 1 = SSP 550 after COVID-19).

In Uganda, a drop in egg prices was reported, from 10,000–12,000 Uganda shillings (UGX) (~USD 2.7–3.2) to UGX 5000–7000 (~USD 1.3–1.9) per tray. The reason was due to the closure of local hotels while primary production continued, leading to over-supply without equivalent demand. The farmers had to sell the eggs on the streets. Peoples' income and purchasing power was eroded because of the disease.

Closure of markets decreased the number of animals slaughtered leading to increases in the price of meat. 'I pass through the Kitengela Market and there was a time when the slaughterhouse was hardly operating,' was an admission by a participant in Nairobi, Kenya. Butchers could not slaughter for fear of not finding people to buy the meat. In Uganda, it was mentioned that butchers needed to notify authorities to be allowed to move animals from farms to the slaughterhouse. Those that could slaughter complained of not being able to sell their meat, reportedly because of the closure of hotels and restaurants which consequently reduced the demand of the product. Access to retail outlets was reduced and people avoided taking food from outside their homes. Also, the introduction of curfew hours and bans on sale of alcohol affected the operations of roast meat ('nyama choma') eateries.

Availability of slaughter animals was a problem especially where these were sourced from neighbouring countries. In Juba, South Sudan, slaughter numbers were said to have reduced because of the pandemic. For cattle, this reduction was from 20–25 head of cattle per day before COVID-19 to about five head of cattle. For sheep and goats, a decrease from 50 to about 10 was reported. It was mentioned that all restaurants sold goat meat and the reduction in slaughter numbers was due to the reduced activity of the food outlets. It was also observed that in Ethiopia, where meat is sometimes consumed raw, the risk of contamination was perceived to be high (unlike in the dairy sector in urban areas where cows are often milked by machines and the milk is not handled multiple times; much of the milk in Addis Ababa is also pasteurized).

The dairy value chain was also affected (although it was reported that the impact was lower because milk is not necessarily traded through markets). Processors could not operate optimally. In Uganda, it was noted that milk producers, especially smallholders, could not easily sell their produce. Although the prices went down, the restrictions meant that consumers could not easily access and buy the milk. A similar observation was made in Burundi which reportedly has several dairy projects; here, milk was available but the demand was low. In Kenya, it was reported that closure of hotels, especially along the coast, affected the milk market. The volumes processed into powder milk could not address the challenge of excess produce, as processors for powder milk were noted to be few. Milk loss due to spoilage was high because the commodity is perishable and must be sold daily. Access to inputs, including feeds, was also mentioned as a challenge in the value chain. In South Sudan, it was reported that milk was usually consumed in households with young children, perhaps a pointer to the age category that was affected most by the disruptions in the supply chain.

The fish value chain was affected in several ways. Ordinarily, fish is known to be an expensive commodity (except for the small sardine type, locally called 'omena'). It was mentioned that people could not afford it during the pandemic. Fish is also very susceptible to contamination, given the frequent handling during harvest, transport and storage. Because of COVID-19 and the travel restrictions, fishermen were not able to engage fully in fishing and this reduced supply and impacted livelihoods. Also, businesses that had stocked fish could not sell and consequently lost income. Fish export was also affected because of the border restrictions and flight cancellations. The challenge of insecurity due to violence especially at the fishing zones was mentioned (although this is not directly linked to the pandemic).

The livestock sector was the first to feel the effect of the pandemic because animal-source foods are normally more expensive than other sources of proteins and households made budget cuts in products deemed to be luxurious.

COVID-19 impact on cereals

Cereals were considered least affected by the pandemic. They are less likely to be handled multiple times and do not provide a good matrix for bacterial growth and survival, therefore are less prone to contamination and subsequent exposure of humans to health risks. Cereals have low moisture content and can be stored for a long period, unlike vegetables and animal-source foods which are highly perishable. This played part in stabilizing supply because they

did not spoil fast. It was also noted that cereal production is not very labour-intensive and moving produce from one place to another, even at short notice, is usually easier, making the commodity available to consumers. As many jobless urban workers returned to the countryside, cereal production was boosted as the locals were encouraged to attend to their crops. Transportation of food was also allowed although some of this occurred at night. Unlike other produce, cereals can be found in other places such as shops and supermarkets, thus one did not need to go to the markets which were considered hot spots for spreading the virus or were closed as a control measure.

COVID-19 impact on vegetables and fruits

The main outlet for vegetables and fruits is through open markets whose operations were affected by the pandemic. Because of the restrictions, the produce could not get to markets, preservation was a challenge and post-harvest loss was high. Some farmers had challenges getting to their farms because of travel bans, hence regular supply of fresh produce, especially to urban areas, was not possible. At the start of the pandemic, some consumers were said to have avoided consuming fruits and raw vegetables for fear of getting exposed to the virus. In Ethiopia, some produce sold in open markets was relocated to other markets, leading to a form of market segmentation and specialization based on produce sold. This was meant to reduce congestion and mitigate COVID-19 spread but instead led to increased distances to the markets, consequently limiting consumers' access to the products.

International trade in fruits and vegetables was impacted by COVID-19 air travel restrictions, resulting in wastage and income loss. South Sudan had abnormally heavy rains which affected production of local vegetables. The above-normal rain led to spoilage of produce in the farms. Labour availability was also restricted. The country also depends on imported vegetables and fruits from Uganda which, because of the pandemic, took long to arrive, leading to spoilage and losses. The travel restrictions meant that South Sudan could not benefit from imported fruits and had to rely on locally produced ones, in short supply, which led to shortages and price hikes. In contrast, in Burundi, it was reported that fruit trucks continued to operate even during the pandemic.

COVID-19 mitigation in food markets

Food markets continued to operate. There was much sensitization regarding hand washing, social distancing and wearing of face masks. Kongowea Market is the largest vegetable and fruit market in Mombasa, Kenya. The government divided the market into two parts, but this was reportedly reversed after the first wave of the disease as infrastructure in the second site was found to be poor. The 'Soko Mjinga' open-air market, also in Kenya (located along the Nairobi–Naivasha Road), was temporarily closed following a COVID-19 scare and the vendors started to operate in a market which they had previously neglected (built under the Economic Stimulus Project). Improvised barriers (wood, rocks) were erected to maintain the required social distance. Few markets, especially those in rural areas, have water for people to wash their hands and enough space for customers and vendors to observe the required social distance.

Livestock markets operated on specific days before the pandemic. Following the pandemic, the strategies applied to food markets were adopted by the livestock markets which started to operate on multiple days in a week, a measure that was meant to address the congestion problem and ensure social distancing. Entry to slaughterhouses was also restricted and buyers were barred from entering the premises. Entry requirements in some slaughter facilities, especially the export ones, were tightened; one participant reported that he was required to show a valid food handler's certificate before being allowed to enter one of the facilities.

Shops, food outlets, eateries and restaurants were required to install handwashing facilities once they were allowed to re-open. Handwashing stations were installed at outlets selling food, including restaurants, markets and slaughterhouses. In Kenya, at the start of the pandemic, the national government, with support from donors, provided water tanks and people were assigned to man them and ensure their use. The Government of Burundi reduced the price of soap by about 50% and the cost of water was also reportedly lowered to encourage compliance with the

handwashing requirements. Some households installed the facilities at their homes and adopted a practice of washing hands before entering the house and washing of products bought from the markets. Sanitizers were recommended but were thought to be too expensive for many people. Slaughterhouses had water stations with sanitizers while the well-established ones operated walk-in sprays.

Mitigation in other sectors

The number of passengers in public buses was reduced. Public service vehicles were allowed to carry a limited number of people. In Kenya, the sitting capacity dictated in the protocol, including the driver, was 10 for 14-seater vehicles, 18 for 33-seaters, 30 for 51-seaters, and 1 for motorcycles ('boda bodas') and 'tuk tuks' (Government of Kenya 2020). Women involved in food businesses in Uganda chose to stay in the markets where they operated, to protect themselves and their families but also because access to public transport was a problem.

It was made mandatory to wear masks; it was felt that their use was more emphasized in cities than in rural areas. Drivers of public service vehicles were fined if found carrying passengers not wearing masks. In Kenya, the public were targeted too and a fine of 20,000 Kenya shillings (approximately USD 200) was introduced for failure to comply. The masks were perceived to be affordable but there was a concern that the very needy people in the community may not afford them, resulting in their reuse or wearing of dirty ones. Also, interestingly, one participant mentioned that masks were viewed as items to be kept by the government and not for use by the public. Perceptions like these may have prompted governments to institute stiffer penalties for failure to wear masks. This may have moved people to comply, not because they were protecting themselves but for fear of being punished.

Supermarkets were affected and, in some areas, some were forced to stop operating because purchasing power was low and they did not have adequate space to observe social distance. Observing social distance in eateries was also said to be a concern. Compliance with wearing of masks was reportedly better in supermarkets as customers were required to sanitize their hands, wear masks and have their temperatures taken. It was mentioned that social distancing was not always maintained at the exit points of the supermarkets.

A concern was raised on how enforcement of COVID-19 mitigation measures was done with minimal consultation with stakeholders. For instance, in one case, the restaurants were closed for a week but opened after it was found that some people fully relied on them for food and were suffering because of the control measures taken. An option for 'take-away' foods was allowed. Issuance of food handler and COVID-19 fitness certificates took long, and this impacted negatively on business in the restaurants and eateries. Although public education through print and electronic media was mentioned, a lack of trust in these was also reported. The lack of media trust by the public can influence COVID-19 mitigation efforts (Zhao et al. 2020).

Compliance in informal markets

Compliance was more visible in formal places: entry to government offices, supermarkets and hotels. It was observed that supermarkets had the capacity to employ guards who controlled the people entering the premises (although it was mentioned that there were times when the guards enforcing the measures got tired and relaxed). Crowding in the informal sector reportedly made enforcement of COVID-19 control measures a challenge. There were those who did not believe the disease exists and were reluctant to adopt the mitigation measures. Some people in the informal sector refused to wash their hands when requested to do so, saying they already had sanitized them. Another challenge was related to the unavailability of water for handwashing in the informal markets. One respondent observed that 'you could go to the market, find water was there but no soap, or soap was there but no water', emphasizing the challenge the markets faced in complying with measures to combat COVID-19. Although water stations were made available, it was noted that people used them for non-intended purposes (for example, they used them when they wanted to go and eat). In Kenya, the issuance of water tanks was politicized and there were concerns over their sustainability and who, between the national government and county governments, would be responsible

for ensuring they were used as intended. It was mentioned that it was the responsibility of market officials to manage these but their utilization was limited given the problem of unavailability of water or soap. Incorrect wearing of masks was thought to be a major problem in these markets. On being probed on the topic, one participant highlighted the difference between 'having a mask and wearing it properly'. In Kenya, it was observed that if 10 vendors were to be sampled randomly at the time of the survey, all would be found wearing masks but only about 25% would have worn them properly while in Uganda, it would be 8 people out of 10. In South Sudan, two different responses were given: one was 1 out of 10 and the other was 4 out of 10 vendors sampled. In Burundi, it was mentioned that none in a sample of 10 vendors would have the mask on.

The struggle by the informal market operators to get food supplies was reported, but this also affected pricing especially of vegetables that needed to be delivered from the villages. It was mentioned that the informal sector operators had requested for support to cushion them from the impacts of COVID-19 and discussions on how this could be achieved was ongoing by the time of the study. It was noted that the formal sector operators were more likely to get support, given that they are more organized, pay taxes and can push for waivers to support their businesses, in contrast to their informal sector counterparts.

COVID-19 and One Health

The Ministry of Health led the implementation of COVID-19 activities. Although formation of COVID-19 task forces was reported, it was mentioned that in some countries, there was no full engagement of other ministries and this limited the application of One Health. Available funds were directed to the Ministry of Health irrespective of duties other ministries were carrying out. There were concerns on the operationalization of the One Health principle despite being formally included in the task force. In Kenya, it was mentioned that the task force initially failed to recognize veterinary services as essential (until one veterinarian was arrested and the Kenya Veterinary Board had to intervene). At the county level, COVID-19 was treated as a pure public health issue with little involvement of other sectors (except when teams visited to undertake assessments). Existing One Health groups were not involved. This was surprising, as noted by one of the experts, given that the departments had worked closely in management of previous disease outbreaks. The failure to recognize COVID-19 as a zoonosis, despite being declared a zoonotic pandemic by World Health Organization, may have contributed to the side-lining of key One Health groups. In addition, health officials may have considered all known transmission was human-to-human and so did not consider the livestock sector so important.

At the start of the pandemic, it was reported that institutions engaged in corporate social responsibility (providing sanitizers, masks etc.) but not much went beyond that. This seems to have been different in Burundi, where it was reported that all the ministries worked together, with the health ministry being recognized as the one that made the effort to involve other sectors (agriculture, water, trade, security, environment etc.) after the first case was reported.

COVID-19 and food safety regulation

Everyone feared being exposed to the virus. People worked from home except those providing essential services. Staff at key border points decreased surveillance. This reportedly reduced the number of staff going to the offices, resulting in a slow-down especially in the implementation of field activities. Working in shifts was reported, which led to delays in responding to office requests, and concerns of people wanting to start operating businesses without approval emerged (and if questioned, they reportedly would say they had already initiated the process with the regulator). It was noted that the inspectors focused more on COVID-19 mitigation and less on food safety compliance. In Kenya, although food handlers were required to get tested for COVID-19, further checks to assess adherence to other food safety requirements (owning a food handler's certificate, uniforms to protect them, running water, waste disposal) were reportedly missing. It was mentioned that the departments needed additional budget to undertake the same work they used to do pre-COVID-19. This was occasioned by the social distancing

requirements, whereby vehicles that used to carry four people were required to carry two people, doubling the resource requirement. In the dairy sub-sector in Kenya, it was mentioned that some unscrupulous people took advantage of the few staff available and started to engage in food safety irregularities. Delays in acquisition of testing tools also contributed to gaps in the implementation of food safety regulations. Absence of systems to assess food safety at homes was another concern.

Food safety concerns during the COVID-19 pandemic

COVID-19 was sudden and people had no time to prepare. The food system was affected in several ways. Table 2 summarizes the key food safety gaps.

Table 2: COVID-related food safety gaps and implications for public health

Identified gap	Implications for food safety
Lack of awareness on food safety	<ul style="list-style-type: none"> No evidence that food can transmit COVID-19. However, poor hygiene and sanitation in areas where food is sold can promote the spread of disease. Handwashing with soap and running water is critical in reducing the spread of pathogens and has been extensively promoted. Hygiene in food markets is critical in reducing the spread of pathogens of public health importance. Limited knowledge on food safety may make consumers fail to read storage instructions when making the purchases.
Bulk purchasing of food products	<ul style="list-style-type: none"> Inadequate storage spaces and improper handling of foods increases the risk of spoilage. Food safety is compromised.
Purchase of cereals that were perceived to last long	<ul style="list-style-type: none"> Seen as a cheaper option. Possibility of purchasing spoilt produce which, in addition to the challenge of proper storage, increases risk of exposure to mycotoxins. Before the pandemic, institutions including schools bought cereals in large quantities (the need for surveillance to assess quality and safety of these was reported). Many of these closed or worked with reduced staff during the pandemic. Groundnuts and risk of aflatoxins also mentioned.
Purchase of expired food products	<ul style="list-style-type: none"> Consumers unknowingly purchased expired products. With increased demand, there was the potential for exploitation by suppliers, forcing products that were nearing or past the expiry date onto the consumers. It was mentioned that supermarkets were warned against selling expired products. Malpractices were reported especially in cases where large quantities were purchased. Not all bags underwent quality checks.
Delay of trucks at the border points	<ul style="list-style-type: none"> Truck drivers were considered a risk for COVID-19 spread in East Africa. Strictness at border points, especially on certification of COVID-19 test results, led to significant delays. Unintended consequences of such measures, including health and hygiene challenges, have previously been reported (Gachohi et al. 2020). Besides the food trucks, the long wait likely had quality and food safety implications as well as environmental effects, depending on how the spoilt products were disposed. Illegal movement and avoidance of inspection at the border crossing points.

Identified gap	Implications for food safety
Handling of fresh produce (fruits, vegetables, animal-source foods)	<ul style="list-style-type: none"> • Fresh produce is perishable and easy to spoil if not well stored, resulting in wastage. Produce that spoils may find its way back to the food value chain. • Animal-source foods provide high-quality proteins and essential micronutrients (Neumann et al. 2002), some of which cannot be found in plant-based foods. Inability to access them can result in serious nutritional and health challenges especially in children and other vulnerable groups. • Animal-source foods can spread important foodborne hazards such as non-typhoidal <i>Salmonella</i> spp., <i>Campylobacter</i> spp. etc. The burden associated with consumption of contaminated animal-source foods has been found to be 35% of global health burden (Havelaar et al. 2015; Li et al. 2019).
Disposal of spoilt products	<ul style="list-style-type: none"> • At farms, homes, markets and national border points. Potential health and environmental impacts.
Regulatory surveillance	<ul style="list-style-type: none"> • Addressed the quantity of food legally moved within and into the countries but needed assessment for safety and informal trade. • There was inability to import food safety testing equipment and difficulty in ascertaining safety.

Businesses closed and livelihoods were lost. Food prices went up and purchasing power was eroded. Available money was used to buy food. With closure of schools, the number of people that needed to be fed increased. In order to feed all, there was a possibility that nutritional requirements may not have been met because of the limited income and the high prices of commodities. Two categories of consumers were observed: an upper class that can purchase what they want and will consider nutrition and safety when purchasing, and another category of consumers who cannot afford to choose and would buy anything if it is cheap. In this latter group were households which started to consume tea without milk to make ends meet while some families were forced to move from urban areas to the villages.

Only trucks could cross the borders, especially at the peak of the pandemic. 'I stay in Bujumbura and we have people from Congo who come to do business in Burundi,' said one respondent, signifying the magnitude of the opportunities lost due to the pandemic. At some other East African country borders, it was mentioned that the trucks were delayed because COVID-19 test results took weeks to be returned, raising public health concerns especially for trucks ferrying non-refrigerated food.

Access to markets was a challenge and consumers' food purchasing patterns, including frequency of shopping and access to variety of choice, were affected. The habit of 'eating away' from home was reduced as people were concerned over the unhygienic handling of the food. 'You cannot go out and eat the food of your choice,' said one participant. As it was unclear what governments would do after first cases were reported, and for fear of stricter measures including possible lockdown, panic and bulk purchasing of food was observed, especially in the 'consumers who could afford' category. In all countries, not all households are connected to the national electricity grid making access to refrigeration a challenge, even if they could afford a fridge, and this affected food storage.

Fresh produce, including vegetables and animal-source products, spoil if not well preserved. It was observed that people preferred products that could last for long. In South Sudan, the list included dry beans, flour and charcoal. There was a mention that long-life milk was preferred more than fresh milk. Despite the preference for long-life milk, in Mombasa, milk dispensing machines were said to have continued to operate. In some places, the use of traditional storage practices resumed and this helped to address the challenge of storage. People in South Sudan preferred to buy salted fish rather than meat that would spoil fast.

Buying of food in bulk was said to destabilize markets and led to artificial shortages. There were instances where the sellers attempted to increase prices, but governments intervened and warned against such behaviours. Bulk purchasing was not experienced much in Tanzania, although there was a rush to get sanitizers.

Consumption and practices changed. Consumers tended to avoid eating raw products especially fruits and vegetables. Cleaning of products before eating became the norm while hands were washed with soap and water before eating. Some people preferred to buy food that would require cooking before consumption as they knew that cooking would kill the virus. People were said to be afraid of buying products that had been handled by multiple people and as such preferred to shop from supermarkets. They avoided street foods (roasted maize etc.) or food from hotels. In Kenya, some consumers preferred buying at roadsides from vehicles selling fresh produce, as these places were considered less likely to be congested with people. In cultures where 'round-table, same-plate eating' is practised, this was stopped and people started to eat away from each other. Consequently, the budget allocation to food also increased as more was needed, given that each person needed to have a plate. Greetings by grasping hands firmly stopped.

Motorcycle riders helped families to get fresh produce from the markets. One would be sent with a list of required items. Some families developed kitchen gardens to address the challenge of food access. Beliefs regarding the benefits of consuming certain food types were reported. For instance, there was a one implying that consumption of ginger, honey, lemon, traditional herbs etc. could provide protection against the disease.

Consumption of animal-source foods declined, not only because of the fear of catching COVID-19 as it was said that the virus may have jumped from wild animals to humans, but mostly because people could not afford the products. Some could afford to purchase a few times in a week while others could not afford at all: 'If you used to eat chicken and beef, now you have to eat beans which are cheaper'. Another factor that contributed to the high prices of animal-source foods, making them unaffordable, was that food animals could not be transported from areas where they were obtained cheaply (goats in northern Kenya) and the low demand caused some markets to stop operating. A participant in Kenya knew of three butchereries that had closed due to the pandemic. Donation of food, by governments or through volunteers, to those who could not afford was reported, but this excluded fresh products.

Because of the transport restrictions, some public vehicles removed passenger seats and started to engage in transporting produce. Informal courier systems emerged, and families, especially those in rural areas, used them to send food to family members living in the cities. Uber (taxi) vehicles started to operate like informal market outlets; the owners sourced produce from farms which they reportedly sold from their car boots. Farmers appreciated the innovations as it meant that they did not have to struggle getting their produce to the market, given the movement restrictions. It was mentioned that, initially, in some rural areas, COVID-19 was perceived to be a disease of the educated (although people sought to know more about it).

Discussion

The COVID-19 pandemic has had profound impacts on food security, nutrition and food systems (HLPE 2020). The most important duty of the state is to protect its citizens from harm (Barrett 2020), perhaps the main reason why each country had to institute measures to mitigate the spread of the pandemic. The measures put in place, including closure of markets, national borders and restrictions on movement, affected food systems in many ways, with variations across countries and regions. In countries with many low-income earners, there is usually a trade-off between implementing public health regulations and their possible negative effects on food security (Sirma et al. 2018). The experts interviewed thought the livestock value chain was the most impacted, and cereals the least. It has already been reported that closure of markets and the localized movement restrictions resulted in serious economic impacts (Mercy Corps 2020). Shortage of feeds and increased prices of dairy meal were reported in Kenya (Odhong et al. 2020). Because of the movement restrictions, the flow of agricultural products from farm to market was interrupted, affecting nutrition and livelihoods. It is worth noting that a diet based on only cereals does not provide all the required nutrients. Animal-source foods are known to provide high-quality proteins and are important sources of bio-available nutrients, among them iron, zinc, calcium and vitamins (Neumann et al. 2002). Vitamin B12, which is synthesized from the gut of the animals, is only found in animal-source foods (O'Leary and Samman 2010). Micronutrients are essential for good health and in building a strong immune system, among others uses. Animal-source foods are perishable and prone to microbial contamination and this limited their access especially at the peak of the pandemic. At least 35% of the estimated global burden of foodborne illnesses comes from consumption of contaminated animal-source foods (Li et al. 2019). Investing in infrastructure to ensure continuous supply of safe and nutritious food is critical for the health and wellbeing of communities.

COVID-19 is not transmitted through food. A study by van Doremalen et al. (2020) evaluated the stability of SARS-CoV-2 and SARS-CoV-1 in aerosols and on various surfaces and estimated their decay rates using a Bayesian regression model. They found SARS-CoV-2 was more stable on plastic and stainless steel than on copper and cardboard, and viable virus was detected up to 72 hours after application on these surfaces. However, aerosol transmission is considered the most important infection route.

Several food safety gaps were reported in the study, but these mainly arose from the measures put in place to contain the spread of the virus. Among these gaps was the failure to undertake routine food safety inspections. Food inspection and monitoring is known to be a critical component of food control systems. At the start of the pandemic, national food safety inspection programs were advised to rank food businesses and use that as the basis to inform inspection programs (FAO/WHO 2020a). This was meant to preserve the integrity of the national food safety control system and to support food trade (FAO/WHO 2020a).

Maize is a staple food in East Africa and its reported purchase in large quantities, as well as the observed storage challenge, may have increased the risk of exposure to aflatoxins. Several outbreaks of aflatoxicosis have been reported in the region. A huge one occurred in Kenya in 2004 in which 317 cases and 125 deaths were reported (Lewis et al. 2005). The risk is particularly high in children weaned on cereal-based products (Magnussen and Parsi 2013). Aflatoxins are classified as Group-I carcinogens (IARC 2012). The other identified concern was that of purchasing expired food products and those nearing expiry periods. Also, it was not clear how any spoiled produce

was disposed of (improper methods could have led to environmental contamination). One of the key objectives of national food control systems is to ensure consumers are protected from fraudulent practices, hence the need to review these and identify gaps that would need to be filled to guarantee this protection. At the same time, there are often unjustified rumours of hoarding during crises and debate as to how much the government should interfere with market operations, especially in low-governance environments. While government intervention is common and often demanded, it is difficult to define hoarding in a meaningful way, let alone justify rules against hoarding on efficiency or social welfare grounds (Sharfman 2006). Interventions aimed at raising the demand for safe food need to be pursued.

The challenge associated with enforcement of COVID-19 mitigation measures, especially in the informal sector, was highlighted. As an example, maintenance of social distancing is not easy, given the settings where the vendors operate and the number of people who frequent these markets daily. Although the use of face masks by sellers and customers was frequently observed, improper use, and recycling, provided opportunities for the virus to spread within the communities. Handwashing points were available but inadequate supplies of water and soap limited their use. A study in Nigeria (Ogoina 2020) outlined the various ways through which masks meant to mitigate COVID-19 have been abused, including wearing them on the chin and neck regions, failure to cover one's mouth and nose especially when talking, use of masks that are dirty, and their indiscriminate disposal in public spaces. Several other factors may play a role in disease transmission, including poor hygiene and sanitation which are a characteristic of many informal food markets. The role of money in transmission of infectious diseases has been discussed (Angelakis et al. 2014) and for COVID-19, human-to-human transmission through cash and coins has been thought to be a possibility (Pal and Bhadada 2020). Where these cannot be avoided, as in the case of many developing countries, the authors advise that people should wash their hands promptly with soap and water immediately after handling the money. Modern technology, including mobile money and digital payment options, has the potential to reduce this risk.

The pandemic has had serious economic implications, both at business level and at the national level (Musabagnwa et al. 2020). It was not clear if informal food vendors were receiving any support to cushion them against the effects of the pandemic (although there were indications that this was being pursued). They will require this support given their high vulnerability levels. However, such should be preceded by an assessment of the gaps in all areas of the food supply chain (Shahbaz et al. 2020) and ranking based on need. The International Monetary Fund (IMF) approved immediate debt service relief to 25 of the IMF's member countries as part of the fund's response to help address the impact of the COVID-19 pandemic (IMF 2020). It is expected that this, and other opportunities that might come up, will support the sector and enable it to recover from the losses that have so far been sustained. In India, rumours of poultry as likely carriers of the COVID-19 virus reduced demand of chicken meat in the country, affecting those that depend on the value chain for their livelihoods (Biswal et al. 2020).

Coronaviruses circulate among animals and people but those in animals may also potentially infect humans (Rizou et al. 2020). SARS-CoV-2 has been classified as a zoonosis (although no animal reservoir has been definitively identified) (Haider et al. 2020), emphasizing the need to employ One Health in its mitigation. It is important to understand the complex nature of disease transmission especially at the animal-human interface and identify factors that would result in successful implementation of interventions. One Health recognizes that the health of humans is closely linked to that of animals and the environment, all of which should be considered when seeking to understand the source of public health diseases. It provides for opportunities to manage threats through multi-sectoral and multi-disciplinary approaches (Kelly et al. 2020). Although another pandemic is inevitable (Dancer 2020), it is impossible to predict its next occurrence (Taubenberger et al. 2007; Morse et al. 2012). Dhama et al. (2020) observe that it was not long after the Severe Acute Respiratory Syndrome and Middle East Respiratory Syndrome outbreaks when COVID-19 struck. Averting future pandemics lies in integrating One Health knowledge on zoonotic diseases along with adopting food safety measures (Aiyar and Pingali 2020). Awareness of the risks of emerging diseases needs to be raised, and One Health gaps that were mentioned by experts engaged in the study will need to be addressed. This would include strengthening the One Health groups that are at various stages of operationalization.

The interview guide was designed to take a short time, and this limited the time available to probe for additional information. A few telephone and internet connection challenges were encountered, given the interview modes used in the study. While this was a qualitative study involving a few food safety stakeholders in the region, some health and food safety gaps were observed which would need to be considered in the mitigation of future pandemics. The study involved most of the leading food safety experts in the region, and their views provide insights that can be used as basis for further research. It has been argued that COVID-19 exposed gaps in many health areas including in infection control (Dancer 2020), hence discussions on the current pandemic should consider filling gaps that existed before COVID-19.

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