

Diabetes & its Complications

A Review and Analysis of the Food Safety Situation in Sierra Leone

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ABSTRACT

Food safety in Sierra Leone has not been treated with the seriousness it deserves. Due to that a review and analysis of the food safety situation in the country was done. During the review of existing literatures and analysis, the following were identified. In many parts of Sierra Leone access to clean water and proper sanitation, these basic requirements are not met, increasing the risk of foodborne illnesses. While foodborne illnesses are a significant concern in Sierra Leone, with outbreaks occurring due to contaminated water, improper food handling, and inadequate sanitation practices. It was revealed that Sierra Leone has food safety regulations in place, but enforcement of those regulations is challenging due to limited resources and capacity. There are also gaps in regulatory coverage, particularly in the informal food markets. Efforts to improve food safety in Sierra Leone often focus on capacity building, including training for food handlers and education for consumers on safe food practices. But Sierra Leone is not thoroughly utilizing the benefit from international collaboration and assistance in strengthening its food safety systems. Like strong partnerships with organizations such as the World Health Organization (WHO) and the Food and Agriculture Organization (FAO) to provide valuable support in this regard as those organization are doing in other sectors they are supporting the country. Climate change is also impacting food safety in Sierra Leone, affecting agricultural production and potentially leading to changes in foodborne disease patterns. Overall, addressing food safety challenges in Sierra Leone requires a multifaceted approach involving improvements in infrastructure, enforcement of regulations, capacity building, and collaboration with international partners. Continuous efforts are needed to ensure that all citizens have access to safe and nutritious food.

Keyword

Food Safety, foodborne illnesses, Water and Sanitation, Food handlers.

Introduction

Today food safety problems have become a foremost apprehension for so many people in the world due to the diseases associated in eating unsafe food that will result in emergence of microbial foodborne pathogens [1]. Food safety is a mixture of numerous scientific method that stresses on lessening and inhibits food-borne disease by guaranteeing harmless intake of food. Food safety should be addressed from the farm to the dinner table. The management of Food safety is a chain that starts with the famer who produces

the raw materials, the food industries and even transporter of all the raw materials and the finished products from the farm to the consumer [2]. All the players along the food chain have a strong role to play for the food to reach the consumer in a safe form that will be healthy for the end user [3]. Access to enough amounts of safe and nutritious food is key to sustaining life and promoting good health [4]. Unsafe food containing harmful bacteria, viruses, parasites or chemical substances causes more than 200 diseases, ranging from diarrhoea to cancers. It also creates a vicious cycle of disease and malnutrition, particularly affecting infants, young children and the elderly [5]. Good collaboration between governments, producers and consumers is needed to help ensure food safety and stronger food systems as reported by WHO [5].

Food safety means assurance that food is acceptable for human consumption according to its intended use. An understanding of food safety is improved by defining two other concepts toxicity and hazard. Toxicity is the capacity of a substance to produce harm or injury of any kind under any conditions while hazard is the relative probability that harm or injury will result when substance is not used in a prescribed manner and quantity. Hazards can be physical, chemical and biological causing harmful / adverse effects on the health of consumers [6].

Billions of people in the world are exposed to danger of eating unsafe food because food is required by everyone. Millions become sick while hundreds of thousands die every year because they consume unsafe food. Therefore, safe food is a guarantee to save lives. Safe food boosts individual and population health. Safe food progresses economic growth of a nation where food safety is practiced and implemented properly. For a nation to have safe food supply it depends on good scientific system, good laboratories, trained and qualified expert in the field of food science and a strong law that the government is willing to enforce without fear or favour. As the world is advancing in technology so too the field of food science is advancing, and producers of food usually will want to take the advantage to produce sub-standard food that will help them maximize their profit. With those technological advances, government of a country must also develop new regulations that are to be enacted to protect a continuing supply of food products that are safe and wholesome for the wellbeing of people [6]. In a nation as the living standard of people is advancing, their life style too changes, so too their food intake [7]. For that reason, concerns over food safety and potential contaminants will continue to be an important health issue. Consumers demand quality and safety of products they consume because food as energy and nutrient is necessary to sustain life [6]. In general, consumers rely on governing authorities to develop strong laws that will ensure all food products not only are safe but are sold as what they claim to contain. If producers and suppliers of food and feed products are not monitored, they will have a field day to do anything that could be detrimental to the lives of the people.

Consumers are becoming increasingly concerned about the health risks posed by microbial pathogens and potentially hazardous chemicals in food. Ready-to-eat foods sold by public food vendors in the cities of the developing world contribute significantly to food insecurity the WHO estimates that up to one-third of the populations of developed countries are affected by food-borne illness each year.

The problem is likely to be even more widespread in developing countries if appropriate actions are not taken to curtail the problem. But food-borne contamination is a global threat not only for developing countries where the sanitary and hygienic conditions are not up to the mark thus facilitating its outbreaks. Comprehensive food safety measures are in need to be opted to restrict the economic burden [6].



Figure 1: The Map of Sierra Leone showing the surrounding countries and the Atlantic Ocean. Map adapted from Magellan Geographix, www.maps.com [8].

Sierra Leone is one of the developing African countries on the West Coast, covering 72,000 square kilometres (28,000 square miles). The Republic of Guinea borders Sierra Leone in the north and northeast and the Republic of Liberia in the east and southeast. Although, the Atlantic Ocean extends approximately 340 kilometres (211 miles) on the west and southwest as shown in Figure 1. Sierra Leone has a total population of 7,534,883 (3,606,085 males and 3,928,798 females) in 6,840 households of which 4,754,139 (63.1 per cent) persons live in the rural and 2,780,842 (38.9 per cent) live in the Urban areas of Sierra Leone [9].

Food Safety Situation Analysis in Sierra Leone

In Sierra Leone, the issue of food safety to so many people is not too common in the market place and even in homes. Food safety is not treated with the seriousness it deserves. Most of the health issues in the country are suspected to be associated to the way people along the food chain handle food products with less knowledge on food safety [10]. The issue of food safety in any nation should be played by several stakeholders like but not limited to the following; government, food technologists/scientists, the producers of the raw material/farmers, input producers, storage, the food markets/dealers and availability of accredited laboratories with required staff [11]. These are key stakeholders that has major role to play to make sure that food presented to the consumers is safe and fit for the purpose for which is prepared.

Work has been done to assess the environment and awareness influencing food safety in the Western Area of Sierra Leone. The studies revealed that the foremost reasons for the unsafe food in

the Western Area of Freetown, the capital city of Sierra Leone are poor hygienic practices which was reported for 38%, infection by flies, it was reported to 28%, exposed food and inappropriate handling with poor personal hygiene was reported to be 21% [10]. Food safety has a very strong link with environmental factors, like unsuitable garbage disposal, it was reported to be 11%. The people interviewed in the Western Area of Sierra Leone articulated that eating food that is not safe causes so many diseases like diarrhoea, those proffer that information were 34%, for food poisoning they are 24%, vomiting is 17%, stomach disorder 16% and typhoid 9% [10].

Western Area is Freetown which the capital city of the country which is by the Atlantic Ocean as shown in Figure 1. Most of the issues of food safety reported in that region of the country could be found in the other four regions (North East, North West, South and East). With what was reported by Kanu et al. [10], it is very clear that the situation needs all the stakeholders along the food chain to play their role in making food reach the end users in a safe form. Foodborne diseases, resulting from poor food handling and sanitation practices, are common public health problems globally [11]. The primary contributing factors to potential foodborne disease outbreaks are often attributed to the poor perception and practices of food handlers regarding food safety as reported by Kanu et al. [10].

In the same research within Western area various measures to improve food safety were cited as hand washing, cleaning the surroundings where food is to be prepared, protecting food from flies and dust (covering the food), proper washing of utensils with different water preferably from a tap running water, trainings for all those along the food chain to know their role in making sure that the food is safe for its intended purpose [10]. Personal hygiene by those handling the food along the food chain as food could be contaminated at any stage hence the reason why Hazard Analysis Critical Points (HACCP) is recommended to be in place. Governments should make food safety a public health priority, as they play a pivotal role in developing policies and regulatory frameworks and establishing and implementing effective food safety systems. Food handlers and consumers need to understand how to safely handle food and practicing basic personal hygiene as prescribed by the WHO [11] Five keys to safer food at home, or when selling at restaurants or at local markets. The Five Keys to safer foods are: (1) Keep Clean; (2) Separate Raw and Cooked Food; (3) Cook Thoroughly; (4) Keep Food at Safe Temperature, (5) Use Safe Water and Raw Material [11]. Producers should also be involved and can safely grow fruits and vegetables using the WHO Five keys to growing safer fruits and vegetables. The aim of this paper is to do an analysis and discuss the food safety situation in Sierra Leone and recommend possible solutions on how to make improvement.

The Important of Safe Food in a Nation

Food safety in a nation is important and very essential because it provides nutritious food to the people of that country which is one of

the bases for the well-being of the people in a country [12]. Unsafe food causes foodborne illnesses, those illnesses are commonly caused by harmful bacteria and pathogens, due to that it poses significant public health threat [13]. These sicknesses can range from mild discomfort to severe cases that require hospitalization. The economic and social costs associated with foodborne illnesses are substantial, that should make a country prioritise food safety a top priority [14]. Recent data and food safety news released by the World Health Organization have estimated that at least 600 million people all over the world become inflicted with foodborne infection after consuming unsanitary food. Of these people, at least 420,000 people die every year. Economic progress can be affected by productivity loss and medical expenses as a result of a foodborne disease burden [15]. When a nation has safe food supply it is important because it reduces the significant disease burden as well as economic burden to that nation.

In US alone, foodborne illnesses each year is reported by Centre for Disease Control (CDC) that 9.9 million: The number of domestically acquired foodborne illnesses that CDC estimates were caused by six pathogens: *Campylobacter* spp., *C. perfringens*, invasive *Listeria*, norovirus, *Salmonella*, and *STEC*. 53,300 of that number of hospitalizations that CDC estimates resulted from domestically acquired foodborne illnesses caused by all seven pathogens. Nine hundred and thirty one (931) of deaths that CDC estimates resulted from domestically acquired foodborne illnesses caused by all seven pathogens [16]. Worldwide, it has been estimated by WHO that every year worldwide, unsafe food causes 600 million cases of foodborne diseases and 420,000 deaths. In the number 30% of foodborne deaths occur among children under 5 years of age. WHO estimated that 33 million yearly of healthy lives are lost due to eating unsafe food globally each year, and this number is likely an underestimation. WHO and CDC reported that these illnesses are responsible for the deaths of about 3 million children a year, mostly in underdeveloped regions [15,17].

Foodborne illnesses associated with microbial pathogens or other food contaminants pose serious health threat in developing and developed countries. WHO estimates less than 10% of foodborne illness cases are reported whereas less than 1% of cases are reported in developing nations [14] of which Sierra Leone is amongst that figure. In another report, WHO estimates 600 million foodborne illnesses and 420,000 deaths in 2010. The most frequent causes of foodborne illness were diarrheal disease agents, particularly norovirus and *Campylobacter* spp. Other major causes of foodborne deaths were *Salmonella typhi*, *Taenia solium*, hepatitis A virus, and mycotoxins especially aflatoxins [14,18]. Children are disproportionately bearing this burden, accounting for an estimated half of foodborne illness cases annually. Children are also among those most at risk of associated death and serious lifelong health complications from foodborne diseases. They are at high risk for foodborne illness for a number of reasons. Children have developing immune systems that are not always well equipped to fight infection; they are often smaller in size than adults, reducing the amount of pathogen needed to make them sick; and children

have limited control over their diets and lack the developmental maturity necessary to carefully judge food safety risks.

From economic perspective, access to sufficient amounts of safe and nutritious food is crucial to sustaining life, promoting good health and economic growth. According to one study, the average cost per case of foodborne illness (in US dollars) was \$1626 for the enhanced cost-of-illness model and \$1068 for the basic model. The resulting aggregated annual cost of illness was \$77.7 billion and \$51.0 billion for the enhanced and basic models, respectively [19]. The study defines basic cost-of-illness model to include economic estimates for medical costs, productivity losses, and illness-related mortality. The enhanced cost-of-illness model replaces the productivity loss estimates with a more inclusive pain, suffering, and functional disability measure based on monetized quality-adjusted life year estimates [14]. With the above reports, it is important to carry out a review analysis of the food situation in Sierra Leone and proffer recommendation on how to improve the situation in the country.

Food Safety in Sierra Leone as an Analysis

The food safety in Sierra Leone which faces several challenges will be analysed addressing those challenges. The challenges ranged from inadequate infrastructure for food handling and storage to limited resources for monitoring and enforcing food safety regulations. The critical challenges the country faces are as follows; (i) Infrastructure, (ii) Water and Sanitation (WASH), (iii) Foodborne Diseases, (iv) Development and Implementation of the Regulatory Framework, (v) Lack of Capacity, (vi) Changes International Collaboration, (vii) use of the appropriate standards for food products and (viii) Climate Change.

Infrastructural Limitation in Addressing Food Safety Challenges in Sierra Leone

In Sierra Leone's infrastructure for food handling and storage has been lacking, especially in rural area [20]. Many small-scale farmers and vendors operate without proper facilities, leading to issues with contamination and spoilage. Infrastructural issues regarding food safety encompass a range of challenges related to the systems and facilities involved in the production, distribution, and consumption of food. Some of the key infrastructural issues in the country are;

- a) **Lack of Adequate Facilities:** The country, particularly in rural areas, lacks proper infrastructure such as electricity to power the refrigerators for the proper storage of food, and transportation networks. This can lead to food spoilage and contamination during storage and transit from the farm to the market and even to the factories. The country is also faced with inadequate sanitation [20]. Proper sanitation practices are crucial at every stage of the food supply chain, from farm to table. Improper sanitation facilities and practices can lead to the contamination of food with pathogens, chemicals, and other harmful substances. Poor waste management practices can contribute to the spread of foodborne illnesses by allowing

pathogens to contaminate food through improper disposal or recycling of waste products as reported by Kanu et al. [10].

- b) **Inadequate food testing and monitoring** has been a major challenge under the infrastructure in the country. Regular testing and monitoring of food products are essential for ensuring safety and quality. However, many stakeholders who are participating along the value food chain lack the necessary infrastructure for conducting these tests effectively, leading to gaps in the food safety protocols. Due to that it limits traceability systems which are crucial for quickly identifying and containing foodborne illness outbreaks [21]. However, many food supply chains lack robust traceability systems, making it difficult to track the source of contamination and prevent further spread [22]. Food traceability systems can decrease evidence irregularity, implement safety governance across terrestrial borders, and support rise customer confidence in food safety to realise a supportable farming growth. From a customer viewpoint, traceability aids to increase confidence, offer peace of mind, and increase self-assurance in the food system. The case of the farmers, traceability is chunk of an overall cost-effective quality management system that can also assist in nonstop development and minimization of the impact of safety hazards. It also facilitates the rapid and effective recall of products and the determination and settlement of liabilities [23]. The implementation and benefits of a traceability system depend on consumers' awareness of food safety, thus an increasing need for such systems that provide transparent information on the quality and safety of food supply chains. The greatest benefit of food traceability could be realized when it is implemented at the entire supply chain level and engages all the participants involved [23].

Water and Sanitation (Wash) Challenge in Addressing Food Safety in Sierra Leone

Another critical problem affecting food safety in Sierra Leone is poor water and sanitation (WASH). Access to clean water and proper sanitation is essential for maintaining food safety. Water is a critical factor in agriculture, nutrition and broader human health. In many parts of Sierra Leone, these basic requirements are not met, increasing the risk of foodborne illnesses [15,24]. Access to clean water and proper sanitation is paramount for maintaining food safety at various stages of the food production and consumption process. Because in the farm for both crops and animals, clean water is essential for irrigating crops, washing produce, and providing drinking water to livestock [25]. Contaminated water used in irrigation can introduce pathogens and pollutants to crops, leading to foodborne illnesses. Proper sanitation practices, such as cleaning equipment and facilities, help prevent the spread of pathogens in agricultural settings [25].

In food processing facilities, water is used for various purposes like cleaning equipment, sanitizing surfaces, and processing food. Contaminated water or inadequate sanitation can lead to the cross-contamination of food products, causing foodborne illnesses. Strict hygiene measures and the use of clean water are crucial to

prevent contamination during processing [25]. In food preparation and handling, clean water is essential for cooking, washing fruits and vegetables, and cleaning utensils and surfaces during food preparation. Sanitation practices in kitchens and food service establishments help prevent the spread of harmful bacteria and viruses that can contaminate food and cause foodborne illnesses. Access to clean water for drinking and cooking at home is essential for consumer safety. Contaminated water can directly affect the safety of food prepared at home, leading to foodborne illnesses [25]. Proper sanitation practices in homes, such as handwashing and cleaning kitchen surfaces, further reduce the risk of food contamination. Waste management and proper sanitation practices include the safe disposal of food waste and wastewater. Inadequate waste management can lead to environmental contamination and the spread of diseases. Treating wastewater before disposal helps prevent the contamination of water sources and reduces the risk of foodborne illnesses [25].

Inappropriate Mechanism to Address Foodborne Diseases

Foodborne diseases can cause illnesses of significant concern in Sierra Leone, with outbreaks occurring due to contaminated water, improper food handling, and inadequate sanitation practices. Foodborne illnesses can indeed pose a significant concern in Sierra Leone, as in many other parts of the world, due to a variety of factors like poor sanitation. Inadequate sanitation facilities and practices can lead to contamination of food with harmful bacteria, viruses, or parasites [10]. This can happen at various stages of food production, processing, handling, and preparation. Lack of access to clean water, is crucial for washing hands, utensils, and food items. Without clean water, there is a higher risk of spreading pathogens through food.

In Sierra Leone due to the low-income bracket of most people there is limited refrigeration and storage facilities in most homes. Proper refrigeration and storage are essential for preventing the growth of bacteria in perishable foods [26]. In regions with limited access to electricity or refrigeration facilities, food may spoil more quickly, increasing the risk of foodborne illnesses.

The country is experiencing too many informal food markets. Many people in Sierra Leone rely on informal food markets where food safety standards may not be strictly enforced [10]. In these markets, food may be sold in unhygienic conditions, increasing the likelihood of contamination [10]. Consumption of unsafe foods which could be easily bought from those unhygienic food vendors is very common as most people access these places from their offices. Certain traditional foods or food preparation methods may carry a higher risk of foodborne illness if not handled properly. For example, consuming raw or undercooked meats, unpasteurized dairy products, or foods prepared under unsanitary conditions can increase the risk of illness [27]. Limited public health infrastructure, in Sierra Leone, like many developing countries, has limited resources and infrastructure for food safety inspections, monitoring, and enforcement of regulations. This can result in gaps in food safety practices and increased risk of foodborne illnesses

going undetected. There is an act on food and feed safety authority 2017 which supposed to have been implemented to create an authority that should be responsible to monitor the sector and bring to book those who fail to comply with the provisions of that act which targets to promote the production and distribution of safe food and feed products in the country [28]. Addressing the issue of foodborne illnesses requires a multi-faceted approach, including improving sanitation and access to clean water, promoting food safety education and training, strengthening food safety regulations and enforcement, and investing in public health infrastructure [29]. By addressing these issues, the prevalence of foodborne illnesses in Sierra Leone can be reduced, improving the overall health and well-being of its population.

Insufficient Regulatory Framework to Address the Food Safety Chancelleges

Regulatory Framework, in Sierra Leone food safety regulations is another major challenge couple with enforcement of the regulatory framework due to limited resources and capacity. There may also be gaps in regulatory coverage, particularly in informal food markets [20]. The regulatory framework plays a crucial role in ensuring food safety in Sierra Leone, as it does in any country. Here are several ways in which the regulatory framework impacts food safety in Sierra Leone: Standards and Guidelines: The regulatory framework sets standards and guidelines for food production, handling, storage, and distribution. These standards ensure that food products meet minimum safety requirements and are fit for consumption. In Sierra Leone, the Sierra Leone Standards Bureau (SLSB) may be responsible for setting such standards but food producers find it difficult to procure those standards. The bureau is responsible for food safety, quality control, and setting national standards. They collaborate with ministries and consumer organizations [30]. Another issue is the inspection and enforcement. The country only developed and enacted the 2017 Food and Feed safety Act that should be responsible to regulate the activities of food producers, export and importers. Food and Feed Safety Act, 2017 aims to: Ensure the safety and quality of food and feed; Protect the public from health hazards; Promote fair trade practices in food and feed [28].

Regulatory agencies are tasked with inspecting food establishments and enforcing compliance with food safety regulations. This includes conducting regular inspections of food processing facilities, markets, and restaurants to ensure adherence to hygiene practices and safety standards. Furthermore, licensing and certification is also a major function that could be carried out should there be a strong regulatory framework in a country. Food businesses are often required to obtain licenses and certifications to operate legally. These licenses may be granted based on meeting certain safety and hygiene criteria as establishes the procedures for obtaining such licenses and certifications in Sierra Leone [28]. But since the authority has not been created yet, those licences for now, are given to food producers by different players like Ministry of Health and Sanitation, Ministry of Water Resources, city and district councils in the country. Export Controls, in the Food and

Feed Safety Act [28] it gives the requirements that governs the import and export of food products to and from Sierra Leone which also includes requirements for labelling, packaging, and quality standards for imported foods to prevent the entry of unsafe products into the country.

The Regulatory agency in a country also has the responsibility to conduct consumer education and awareness risen activities using competent authorities [31]. In Sierra Leone there are consumer agencies but hardly engage the public on awareness risen activity that will educate the citizen about the dangers associated in consuming unsafe food. In other countries regulatory agencies often play a role in educating consumers about safe food practices and informing them about potential food safety risks. This may involve public awareness campaigns, dissemination of educational materials, and collaboration with media outlets to raise awareness about food safety issue. During that it will be easy for the country to create a response mechanism to food safety incidents, because of lots of stakeholders are involved. In the event of foodborne illness outbreaks or other food safety incidents there should be an agency to handle the issue [31].

In Sierra Leone the country recently established the National Public Health Agency that is responsible to investigate all public health issues in the country and implementing corrective actions and preventing future occurrences. The agency was established in 2023 but it works in collaboration with other government agencies, healthcare providers, and international organizations. This move might help in responding swiftly to incidences of foodborne illness outbreaks [32].

The regulatory framework may include provisions for building capacity and providing training to food industry professionals on food safety practices. This will help to ensure that individuals involved in food production, handling, and distribution are knowledgeable about best practices and regulations. A robust regulatory framework is essential for safeguarding public health and ensuring that food products in Sierra Leone are safe for consumption. Effective implementation and enforcement of food safety regulations are key to preventing foodborne illnesses and promoting consumer confidence in the food supply.

Capacity Building in Addressing Food Safety Challenges

Efforts to improve food safety in Sierra Leone must focus on capacity building which include training for food handlers and education for consumers on safe food practices. But this is lacking for the moment. Capacity building plays a crucial role in improving food safety in a nation, as it enhances the country's ability to implement and enforce food safety regulations, adopt best practices, and build a skilled workforce in the food industry [33]. Some of the areas, capacity building impacts food safety in a nation are; training and education to farmers, food processors, distributors, and regulatory officials on best practices in food handling, storage, and food transporters. This helps reduce the risk of contamination and spoilage throughout the food supply chain

[34]. Capacity building helps regulatory agencies develop and enforce food safety regulations effectively. By training officials on regulatory standards and inspection procedures, they can ensure that food businesses comply with safety standards, leading to safer food products for consumers. These improvements enable those along the food chain do better monitoring of food products to reduce contaminants and pathogens, ensuring that only safe food reaches the consumers [26].

Through investments in food safety infrastructure and grower training, capacity building efforts aim to improve food safety along the food production value chain, without destabilizing imported food supply. Also, capacity building programs help build the expertise needed to assess and manage food safety risks effectively. This includes identifying potential hazards, implementing preventive measures, and responding swiftly to food safety incidents or outbreaks. Capacity building efforts often include training people that are to engage the public to raise awareness about food safety practices and empower consumers to make informed choices. This can lead to increased demand for safe food products and pressure on food businesses to maintain high safety standards [33].

When the capacity of those engage in the production process in any nation it enhances the ability of that nation to participate in international trade by meeting the food safety requirements to export to international food markets. This can open new market opportunities which will contribute to the economic growth of that nation [33]. This is not seen happening in Sierra Leone which makes the country to struggle in entering the global market for most of the food produced in the country, hence a contributing factor to the inflation the country is currently experiencing [35]. Capacity building plays a vital role in improving food safety in a nation by strengthening regulatory frameworks, building technical expertise, upgrading infrastructure, raising awareness, and enhancing the overall safety and quality of the food supply chain.

International Collaboration

International collaboration is one of the factors that hinders the country on food safety. Nations benefit from international collaboration and assistance in strengthening its food safety systems of which Sierra Leone stands to benefit. Partnerships with organizations such as the Food and Agriculture Organization (FAO) and World Health Organization (WHO) can provide valuable support in this regard. Those two United Nations Agencies are responsible for issues pertaining to food and how it should be presented to the consumers in a safe form. They are responsible in the development of standards and procedures of food and food industries respectively. The organization that is directly responsible for all food standards which is the Codex Alimentarius Commission (CAC) has 189 codex members of which 188 are member countries and 1-member organization which is the European Union. The Codex Alimentarius which is 'food code' is a collection of intentionally recognized standards, codes of practices, guidelines and recommendations for the

production and utilization of food [36]. The Codex Alimentarius Commission is a body established in early November 1961 by FAO and WHO joined in June 1962 and organized its meeting in Rome in October 1963 [37]. Sierra Leone became a member of the CAC in 1980. With that in mind, food safety in Sierra Leone should have been in a different level of understanding by the populace if such international collaboration has been promoted.

Sierra Leone could derive several benefits from international collaboration and assistance in strengthening its food safety systems. The benefits could be; technical expertise exchange, collaborating with international organizations and experts can provide Sierra Leone with access to specialized knowledge and technical expertise in food safety practices, including risk assessment, hazard analysis, and quality control measures. The other benefits could be capacity building; international assistance can support capacity-building initiatives, such as training programs for food safety professionals, laboratory technicians, and agricultural extension workers. This could enhance local expertise and infrastructure for monitoring and ensuring food safety standards.

International collaboration could also be of benefit in regulatory support. International collaboration can assist Sierra Leone in developing and implementing robust regulatory frameworks aligned with international standards, such as those established by the Codex Alimentarius Commission. This can improve regulatory oversight, enforcement, and compliance within the food industry.

Another benefit could be infrastructure development. Assistance from international partners can facilitate the development of essential infrastructure for food safety, including laboratory facilities for testing food samples, cold storage facilities for perishable goods, and transportation systems to maintain the quality of food products along the supply chain. Market Access could also be another international collaboration benefit a nation like Sierra Leone stands to gain. Strengthening food safety systems can enhance Sierra Leone's ability to meet international food safety standards, thereby improving market access for its agricultural products. This can lead to increased trade opportunities and economic growth for the country.

The other benefit is public health protection: By improving food safety practices and standards, international collaboration can help reduce the incidence of foodborne illnesses and outbreaks in Sierra Leone. This not only protects public health but also contributes to improved productivity and economic development by reducing healthcare costs and lost productivity associated with foodborne diseases. And resilience to external shocks can enhanced food safety systems that will increase Sierra Leone's resilience to external shocks, such as food contamination incidents or global health crises like pandemics [31]. By ensuring the safety and reliability of the food supply, the country can better withstand disruptions and maintain food security for its population. International collaboration and assistance in strengthening food safety systems

can contribute to improved public health, economic development, and food security in Sierra Leone, while also fostering partnerships and knowledge exchange on a global scale.

Challenge of Climate Change on Food Safety

Climate change can immensely impact food safety in Sierra Leone, affecting agricultural production and potentially leading to changes in foodborne disease patterns. Climate change can have significant impacts on food safety in Sierra Leone, primarily through its effects on agricultural production, water resources, and the spread of foodborne diseases [38,39]. The following are some ways in which climate change can impact food safety in Sierra Leone; Changes in Agricultural Production - Climate change can alter temperature and precipitation patterns, leading to changes in the availability and productivity of crops. Extreme weather events such as droughts, floods, and storms can damage crops and reduce yields, affecting food security and potentially leading to foodborne illnesses due to scarcity or contamination of food. Another effect is water contamination. Increased flooding caused by climate change can lead to contamination of water sources used for irrigation, drinking, and food processing. Contaminated water can introduce pathogens and pollutants into the food supply chain, increasing the risk of foodborne diseases such as cholera, typhoid, and diarrheal diseases [40].

Proliferation of Foodborne Pathogens- Changes in temperature and humidity can create favourable conditions for the proliferation of foodborne pathogens such as bacteria, viruses, and fungi. Higher temperatures can accelerate the growth of bacteria like Salmonella and E. coli, which can contaminate food during production, handling, and storage, posing risks to public health [41].

Climate change on Livestock: Climate change can also affect livestock health and productivity, leading to potential food safety risks. Heat stress, disease outbreaks, and changes in forage availability can impact the quality and safety of meat, milk, and other animal products. Even vector-borne diseases through climate change can influence the distribution and abundance of vector-borne diseases such as malaria and dengue fever, which can indirectly affect food safety by impacting agricultural workers' health and productivity [42].

Food Supply Chain Disruptions: Extreme weather events and environmental changes can disrupt transportation, storage, and distribution networks, leading to food shortages and increased vulnerability to food contamination during handling and processing.

But addressing these challenges requires comprehensive strategies that integrate climate adaptation, food safety measures, and sustainable agricultural practices. This may include improving water management, promoting climate-resilient crop varieties, enhancing food safety standards and regulations, strengthening surveillance and monitoring systems for foodborne illnesses, and building capacity for climate change adaptation among farmers, food producers, and public health authorities. Collaboration

between government agencies, international organizations, research institutions, and local communities is essential to mitigate the impacts of climate change on food safety in Sierra Leone.

Government's Role to Regulate and Enforce Food Safety

Safe food supply depends on both sound science and equitable law enforcement. Periodically, new laws and regulations must be enacted to further protect a continuing supply of food products that are safe and wholesome for the health and wellness of people. In most countries, the overarching goal of having Food Safety Agencies is to take responsibility for compliance of food safety law to ensure a three-fold aim in protecting public health and safety: (1) inform citizens of nutrition and components of important food products; (2) enforce existing laws and regulations on food industry to ensure supply of safe food products; and (3) investigate and eliminate potential toxic contaminants and prosecute economic fraud via regular monitoring and surveillance on chain of food supply.

Once the laws are enacted, they must be enforced to ensure compliance by the entire food industry including industries that are directly or indirectly connected with the food source, labelling, packaging, transportation, distribution down to retail sales. The Food Safety Agency must be given resources and authority to write rules and regulations, assemble experts both as agency employees or consultants so to fulfil the three-prong aim of informing, enforcing and eliminating any food related safety risk.

All governmental agencies involved in potential food chain supply must be given resources and authorities to discharge the 3-fold duty of (1) inform, (2) enforce, and (3) eliminate as described above. In addition to Food Safety Agency, other governmental agencies collaborations are required. For example, Ministry of Water Resources are in charge of water, while EPA is in charge of clean air, and nontoxic natural resources such as soil and land in Sierra Leone.

Conclusion

Sierra Leone needs to address the infrastructure, water and sanitation, foodborne diseases, develop and implement strong regulatory framework, build the capacity of those that are expected to work within the food chain, build a strong international collaboration, develop the appropriate standards for food products and address the issues of climate change. When that is handle the country, will be on the right trajectory in addressing food safety issues in the country.

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