A FOOD SYSTEMS APPROACH TO DESIGN A RISK-BASED FOOD CONTROL BORDER FRAMEWORK FOR ZAMBIA: A CASE STUDY OF NAKONDE AND CHIRUNDU ONE-STOP BORDER POSTS (OSBP)

BY

MWANGELWA CHARLES MATONGO

A dissertation submitted to the University of Zambia in partial fulfilment of the requirements for the award of the Master of Science in Food Safety and Risk Analysis

The University of Zambia

School of Veterinary Medicine

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DECLARATION

I, **MWANGELWA CHARLES MATONGO,** do hereby declare that the contents of the dissertation being submitted herein are my original work and have not been previously submitted to any University for the award of a degree or any other qualification.

Signature---------- Date----------

APPROVAL

This dissertation submitted by MWANGELWA CHARLES MATONGO is approved as fulfilling the requirements for the award of Master of Science in Food Safety and Risk Analysis of the University of Zambia.

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Supervisor	Signature	Date
Examiner:	……	……..
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Chairman (Board of Examiners) …….		……..……
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DEDICATION

This thesis is dedicated to my spouse and our three children, whose love and belief in me lit the way, and to my family and friends, whose unwavering support made this journey possible.

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LIST OF ACRONYMS AND ABBREVIATIONS

8NDP	Eighth National Development Plan
AfCFTA	African Continental Free Trade Area Agreement
CCPC	Competition and Consumer Protection Commission
COMESA	Common Market for East and Southern Africa
DVS	Department of Veterinary Services
ERES	Excellence in Research and Ethics and Science
EU	European Union
FAO	Food and Agriculture Organisation of the United Nations
FBD	Food-borne disease
FBO	Food Business Operator
GFSI	Global Food safety Index
GMO	Genetically modified organism
HIV/AIDS	Human immunodeficiency viruses / acquired immunodeficiency syndrome

IRB	Institutional Review Board
IRH	International Health Regulations
JEE	Joint External Evaluation
MOH	Ministry of Health
NALEIC	National Livestock Epidemiology and Information Center
NBA	National Biosafety Authority
NHRA	National Health Research Authority
OSBP	One Stop Border Post
PQPS	Plant Quarantine Phytosanitary Service
SADC	Southern African Development Community
SI	Statutory Instrument
SPS	Sanitary and phytosanitary
TBT	Technical barriers to trade
TRS	Time release study
WHO	World Health Organisation
WTO	World Trade Organisation
ZBPUP	Zambia Border Post Upgrading Project
ZCSA	Zambia Compulsory Standards Agency
ZEMA	Zambia Environmental Management Agency

ABSTRACT

This study investigates the effectiveness of food safety control systems at Zambia's border posts, focusing on institutional capacities, infrastructure readiness, and inter-agency coordination. Against the backdrop of increasing regional trade under frameworks such as the AfCFTA, and persistent challenges in preventing foodborne hazards, this research provides a thematic analysis of systemic gaps compromising food safety governance at border points. Using a qualitative case study design, data were collected through key informant interviews with officials from regulatory agencies, supported by policy document reviews.

Findings reveal four interlinked themes: (1) Human Resource Constraints, including severe staffing shortages and dual responsibilities, limiting oversight and responsiveness; (2) Infrastructure and Technology Gaps, such as the absence of dedicated sample transport, laboratory space, cargo scanners, and reliable internet connectivity; (3) Coordination and Information Exchange Deficits, particularly poor communication between border and inland teams and limited feedback mechanisms; and (4) Policy and Operational Inefficiencies, marked by fragmented mandates, lack of risk profiling, and minimal automation in back-office operations. The research highlights how these structural and functional weaknesses compromise Zambia's compliance with international food safety norms and impede timely interventions at points of entry.

The study concludes with a call for enhanced investment in border inspection infrastructure, institutional mandate alignment, targeted staffing reforms, and the adoption of integrated risk-based frameworks. It recommends a coordinated national approach aligned with Codex principles and WTO SPS requirements to ensure effective food control and trade facilitation. The findings contribute to evidence-based policymaking for strengthening Zambia's food safety systems within regional and global trade ecosystems

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CHAPTER ONE

INTRODUCTION

1.1. Background

Over time, food safety hazards and their transmission routes have evolved due to advancements in food production methods and global distribution, shifts in diets and eating habits, the emergence of new foodborne pathogens, and the impacts of climate change (Faour-Klingbeil et al., 2022). Between 2000 and 2020, the global trade in food and agricultural products nearly tripled, driven by tariff reductions under international and regional trade agreements (FAO & WTO, 2021). A significant contributor to this boom has been the reduction in tariffs resulting from implementing global and regional trade agreements. This proliferation of trade has expanded the food supply chain, incorporating many new partners worldwide (Keener et al., 2014).

While offering numerous opportunities, this expansion of trade poses challenges such as the emergence of new food-borne hazards and regulatory asymmetry, especially concerning discordant prioritisation of food safety. Methods of production and processing, as well as the paths that food travels along from farm to fork, are continuously evolving (FAO and WTO, 2017). Regulatory agencies, the food industry, and consumers now face the mammoth task of ensuring the safety of food items traversing national borders, involving various jurisdictions and practices. Unsafe food containing harmful bacteria, viruses, parasites, or chemical substances is responsible for over 200 diseases, from diarrhoea to cancers (Gizaw, 2019). The risks are not hypothetical. In the United States, for instance, nearly half of the reported outbreaks of food-borne illnesses in 2009 and 2010 were linked to imported food (Keener, Nicholson-Keener and Koutchma, 2014). Diarrheal diseases are the most common presentation of foodborne infection (WHO, 2017) and remain a global concern, especially in developing countries (Kirk et al., 2015; Liu et al., 2015). The WHO estimated that 33 million years of healthy lives are lost due to eating unsafe food globally each year. More than 91 million people fall ill each year from Foodborne diseases (FBD), accounting for 142,000 deaths in Africa, representing one-third of the annual global death toll. (WHO Estimates on Global Burden of Foodborne Diseases, 2015).

In Zambia, data on foodborne illness is not readily available (Hakobyan, 2014). While the extent of foodborne risks in Zambia is not fully known, recurrent cholera and typhoid outbreaks and the fact that 60 per cent of the population suffers from diarrhoea suggest that foodborne pathogens, poor hygiene and sanitation and other food safety risks have a negative impact (Hamooya, Masenga and Halwiindi, 2020). Diarrhoea is the third largest killer of children under the age of five in Zambia. It is estimated that 15,000 die yearly due to the disease, representing 19% of all deaths among under-five children (Nyanga and Siziya, 2019). The weak health system infrastructure and lack of human and financial capacity intensify the disease burden in Zambia.

Globally, the international community has witnessed a significant evolution in the deployment of advanced food control systems, particularly in regions characterized by bustling trade networks, such as the European Union (Pettoello-Mantovani, 2022). These sophisticated systems are designed to strike a delicate balance between ensuring public safety and optimising trade efficiency. By adopting a risk-based approach (Barlow et al., 2015), these systems strategically allocate resources to areas of highest concern, thereby maximizing their effectiveness. This targeted strategy not only enhances the protection of consumer health but also facilitates smoother and more efficient trade operations, fostering economic growth and international collaboration. As a result, such systems have become a cornerstone of modern food safety governance, setting a benchmark for other nations to emulate in their pursuit of harmonising public health priorities with global trade demands.

Regionally, within Africa, countries face complex challenges in establishing effective food control systems, largely due to the continent's vast diversity in climates, agricultural practices and infrastructural capacities. The continent's climatic variations, ranging from arid deserts to tropical rainforests, create distinct agricultural outputs and food safety risks, necessitating tailored approaches to food control (Grace, 2015). Additionally, the prevalence of smallholder farming, which accounts for approximately 60% of agricultural production in sub-Saharan Africa, poses unique challenges in ensuring consistent food safety standards (Makurira, 2011).

Infrastructural limitations further exacerbate these challenges. Many African nations struggle with inadequate cold chain facilities, limited laboratory capacities for food testing, and insufficient regulatory frameworks (UNIDO, 2023). These gaps are particularly pronounced at border crossings, where the movement of goods between countries with varying food safety

standards can lead to the spread of foodborne illnesses and the entry of substandard or counterfeit products (World Bank, 2022).

Despite these hurdles, there is an increasing acknowledgment throughout the continent of the essential need for strong food control systems, especially at border crossings. Regional bodies such as the African Union (AU) and the Economic Community of West African States (ECOWAS) have prioritised harmonising food safety regulations to facilitate trade while safeguarding public health (AU, 2015). For instance, the African Continental Free Trade Area (AfCFTA) agreement emphasises the importance of aligning food safety standards to boost intra-African trade and reduce reliance on imports.

Moreover, initiatives like the Borderless Alliance and the Sanitary and Phytosanitary (SPS) Policy Framework aim to streamline border procedures and enhance food safety inspections, reducing delays and preventing the entry of unsafe food products (African Union, 2019). These efforts are supported by international organisations such as the World Health Organization (WHO) and the Food and Agriculture Organisation (FAO), which provide technical assistance and capacity-building programs to strengthen food control systems across the continent (FAO, 2006).

Countries must also prioritise the safety and quality of their food products entering international markets, as well as rigorously verify that imported foods comply with domestic standards, to safeguard public health, maintain consumer trust, and ensure fair trade practices (Gizaw, 2019). This dual responsibility is critical in an increasingly interconnected global food system, where the movement of food across borders has become a cornerstone of economic development and food security.

The stakes are even higher in Zambia, a country deeply embedded in this global web of food trade. Over 70% of Zambia's imports are intermediate goods and consumer goods (Zambia Statistical Agency, 2024). The food, tobacco and beverages subsector represent 60% of the manufacturing sector's GDP contribution (MCTI, 2018). As a net food importer with limited exports, Zambia relies heavily on the safety and quality of imported foods. However, being resource-poor with an estimated poverty incidence of 60.0 % (Zambia Statistics Agency, 2023) poses an inherent challenge: balancing efficient trade processes with effective safety controls.

Furthermore, despite the important role of food control systems in safeguarding public health and ensuring compliance with international trade standards, Zambia's border food safety mechanisms remain inadequately assessed. Current research on food safety in Zambia has primarily focused on public health impacts and agricultural production, with limited attention given to the efficacy of border food inspection systems in mitigating risks associated with imported goods. There is also a lack of comprehensive studies benchmarking Zambia's border food control measures against global and regional best practices, limiting opportunities for regulatory improvement. While international frameworks such as the Codex Alimentarius and regional initiatives like the African Continental Free Trade Area (AfCFTA) emphasize harmonized food safety standards, Zambia's existing border control system struggles with implementation gaps, including resource constraints, fragmented institutional roles and inconsistent enforcement of food safety regulations. Additionally, the absence of a structured risk-based inspection framework leads to inefficiencies in food monitoring, increasing the likelihood of substandard or contaminated food entering the country. This study aims to bridge these gaps by evaluating current food control practices at the Nakonde and Chirundu border posts, identifying key operational and institutional challenges, and proposing a more adapted, risk-based framework that aligns with international best practices.

1.2. Problem Statement

Over the past two decades, global food trade has expanded significantly, increasing economic opportunities while elevating food safety risks (FAO, WHO and WTO, 2019). From 2016 to 2018, 85% of food consumed in Africa, valued at over USD 35 billion annually, was imported, underscoring the importance of effective food safety controls (FAO, 2019). In Zambia, a net food importer with notable food insecurity challenges, food control is managed by a multiple-agency system. Key players include the Zambia Medicines Regulatory Authority, the Zambia Bureau of Standards, and local border authorities, who enforce standards across 19 border posts (MCTI, 2023).

Important checkpoints such as the Nakonde and Chirundu one-stop border posts are central to Zambia's strategy for managing imported foods. However, these posts often suffer from inadequate infrastructure, limited ICT resources, and shortages of skilled personnel, which impede the effective execution of food safety inspections (Muqayi et al, 2025; EU, 2023, Willie 2020). Several recent incidents have highlighted this system's limitations, including the 2020

recall of canned pilchard products and the 2021 recalls of Ceres apple juice and Appletiser sparkling apple juice due to safety concerns (Zambia Statistics Agency, 2022).

Given that approximately 650,000 tons of food, valued at over USD 1.1 billion, are rejected annually by importing countries on safety grounds (FAO, 2029), it is essential to assess the current effectiveness of Zambia's border food control systems. This evaluation focused on the operational capacity of key border posts like Nakonde and Chirundu and identifies areas where a more resilient, risk-based framework can be implemented to protect public health and maintain consumer confidence (World Customs Organization, 2018).

1.3. Study Justification

The justification for this study lies in the critical need to enhance food safety measures at Zambia's border posts to safeguard public health and ensure compliance with international trade standards. The expansion of global food trade has brought about increased exposure to food safety risks, necessitating robust control systems (FAO, WHO and WTO, 2019). Effective food safety controls are paramount for Zambia, given its status as a net food importer and the significant role of imported foods in the national diet (FAO, 2019).

The multiple-agency system currently in place for food control in Zambia faces several challenges, including inadequate infrastructure, limited ICT resources, and shortages of skilled personnel (Muqayi et al, 2025; EU, 2023, Willie 2020). These issues hinder the effective execution of food safety inspections and compromise the ability to prevent foodborne illnesses and contamination. Recent recalls of food products due to safety concerns underscore the urgency of addressing these limitations (Zambia Statistics Agency, 2022).

By evaluating the operational capacity of key border posts like Nakonde and Chirundu, this study aims to identify areas for improvement and propose a more resilient, risk-based framework for food control. Such a framework will enhance the efficiency and effectiveness of food safety inspections, reduce the incidence of foodborne illnesses, and bolster consumer confidence in the safety of imported foods (World Customs Organization, 2018). Furthermore, strengthening food safety measures at border posts will support Zambia's compliance with international trade agreements, thereby facilitating smoother trade operations and contributing to economic growth (PMRC Zambia, 2021).

1.4. General Objective

To evaluate the effectiveness of Zambia's border food control systems at Nakonde and Chirundu one-stop border posts, identify key operational challenges and propose targeted recommendations for strengthening food safety measures in line with global and regional trade dynamics, and the following are the specific objectives:

i. To evaluate the current food control practices at Nakonde and Chirundu (As-Is Scenario) and identify their strengths and weaknesses;
ii. To benchmark Zambia's border food control measures against global and regional best practices (To-Be Scenario); and
iii. To identify and address infrastructural, procedural and institutional challenges hindering effective food control measures.

1.4. Research Questions

The study responded to the following research questions:

i. What are the current food control practices at Nakonde and Chirundu border posts and what are their key strengths and weaknesses?
ii. How do Zambia's border food control measures compare to global and regional best practices?
iii. What infrastructural, procedural and institutional challenges hinder the effectiveness of food control measures at Nakonde and Chirundu, and how can they be addressed?

CHAPTER TWO
LITERATURE REVIEW

2.1 Background to food control at border posts

Food security and the right to safe food are frequently discussed in international discourse (Toma-Bianov and Saramet, 2012). As a fundamental human necessity, food must not only be available and affordable but also meet safety standards (Barinda and Ayuningtyas, 2022). The United Nations World Food Programme emphasizes that food security exists when people have access to enough safe and nutritious food for normal growth and development, and an active and healthy life (World Food Programme, 2025). The right to adequate food is recognized as a human right by the United Nations Human Rights Office, highlighting the importance of safe and nutritious food for all individuals (UN Human Rights Office, 2025).

Regulations related to food safety were first brought to the forefront after NASA required Pillsbury, a food processing company, to provide pathogen-free food for a space mission in the early 1960s (Ibrahim, 2020; Weinroth et al., 2018). This led to the development of the Hazard Analysis and Critical Control Point (HACCP) system, which has become the global standard for food safety management (NASA, 2020).

The relationship between food trade and safety has become a critical component of contemporary global and regional economies. This is mainly due to scientific advancements that have seen the application of automation, artificial intelligence, big data, and blockchain to enhance the potential for effective food safety management (United Nations Development Programme, 2021). Artificial intelligence and big data are being leveraged to improve food safety through real-time contamination detection, predictive risk modeling, and compliance monitoring (Dhal and Kar, 2025). Blockchain technology is also being used to enhance traceability and transparency in food supply chains (Zhou et al., 2021).

As countries increasingly open their borders to facilitate trade, food quality and safety stakes have risen exponentially, resulting in a significant rise in non-tariff measures (NTMs), whose economic costs are estimated to amount to $1.4 trillion, representing 1.6% of the global gross domestic product (Marks, 2020). Non-tariff measures, such as sanitary and phytosanitary standards, are designed to protect human, animal, and plant health but can also create significant

barriers to trade (United States Trade Representative, 2025). These measures often require exporters to comply with stringent standards, which can be costly and time-consuming (Gourdon and Nicita, 2013; Shepherd and Wilson, 2013).

The growing threat of aflatoxin contamination in staple foods such as cereals and groundnuts, along with pesticide residues in fresh produce and veterinary drug residues in meat and dairy products, underscores the important need for stringent food safety measures (Humphrey, 2017). Aflatoxins, produced by Aspergillus fungi, are potent carcinogens that can contaminate a wide range of food commodities (Kumar et al., 2021). Pesticide residues in food can pose acute and chronic health risks, necessitating strict regulation and monitoring (World Health Organization, 2022). Veterinary drug residues in meat and dairy products can also pose health risks to consumers, including antibiotic resistance and allergic reactions (Falowo and Akimoladun, 2019).

Given the intricate relationship between food standards and international trade, a rigorous regulatory system is essential to ensure that food crossing borders meets the highest safety standards (FAO, 2017; WTO, 2017). Effective food control at border posts is crucial for protecting public health and ensuring the safety of imported food products.

However, achieving a balance between efficient trade processes and effective food safety controls remains a significant challenge, particularly for nations engaged in multiple trade routes. The increasing complexity of the global food supply chain further exacerbates this issue, creating an environment where food fraud related to safety and quality becomes both easier to commit and more difficult to detect (Onyeaka et al., 2013). Global food systems have become increasingly complex due to technological innovations, globalization, and the extensive network of interrelated processes involved in food production, processing, distribution, and consumption (Loring and Sanyal, 2021). This complexity can lead to vulnerabilities in the supply chain, making it challenging to ensure food safety and quality (Sutar et al., 2025).

Food fraud, which includes activities such as dilution, substitution, concealment, and mislabeling, poses significant economic and health risks to consumers (Food Safety Institute, 2024). The intentional adulteration or misrepresentation of food products for economic gain can compromise the integrity of the food supply chain and undermine consumer trust (GFSI, 2018).

In this context, Zambia, with its land-linked position in Africa and intricate food trade dynamics, faces a particularly pressing challenge. Zambia's strategic location makes it a key transit point for food products moving across the continent, but it also exposes the country to various food safety risks (World Bank, 2021). Addressing these risks requires a coordinated approach to strengthen regulatory frameworks, enhance monitoring systems, and foster regional and international cooperation. The Food Safety Act of 2019 provides a legal framework for protecting public health and ensuring food safety in Zambia, but effective implementation and enforcement are crucial (National Assembly of Zambia, 2019).

Strengthening regulatory frameworks involves conducting regulatory impact assessments, improving coordination between policy actors, and ensuring that regulations are aligned with international standards (PMRC, 2021). Enhancing monitoring systems includes adopting advanced technologies such as blockchain and the Internet of Things to improve traceability and transparency in the food supply chain (Zhou et al., 2021). Fostering regional and international cooperation is essential for addressing transboundary food safety issues and ensuring that food products meet the highest safety standards (FAO, 2017).

2.2 Global Perspective on Food Control at Borders

In the contemporary era of globalisation, food products move across international borders with unprecedented ease. Globally, 1.3 billion people or 17 % of humanity, are estimated to be predominantly fed through international trade (Wolff, 2020). The annual value of trade in food and agricultural products has grown almost three-fold over the past two decades (2000-2020), largely due to reduced tariffs from implementing global and regional trade agreements (FAO & WTO, 2021). While economically beneficial, this rapid and voluminous movement of traded food commodities has escalated the complexities surrounding food safety and quality (Adinolfi, Di Pasquale and Capitanio, 2016). Several global standards and best practices have emerged as countries navigate the challenges of ensuring food safety while facilitating trade (Kelly, 2005).

2.2.1 Global Standards and Best Practices

A universally accepted premise is that food, irrespective of origin, should be safe and of acceptable quality when it reaches the consumer (WHO and PAHO, 2017). To achieve this, many countries have adopted risk-based approaches, focusing on preventative measures and

traceability (Banerjee and Menon, 2015). This involves assessing potential hazards, implementing measures to control these hazards, and ensuring a means to trace products should issues arise. Risk-based approaches are integral to modern food safety management, as they prioritize resources towards the highest risks, enhancing efficiency and effectiveness in food safety controls (FAO, 2025).

Moreover, harmonising standards with international guidelines, like the Codex Alimentarius, is becoming a best practice to ensure food safety while avoiding unnecessary trade barriers (FAO & WTO, 2017). The Codex Alimentarius Commission, established by FAO and WHO, develops science-based food standards, guidelines, and codes of practice that serve as benchmarks for national regulatory frameworks (Codex Alimentarius Commission, 2023). These standards cover critical areas such as food hygiene, labelling, additives, and contaminants, and are recognized globally for their role in protecting consumer health and facilitating fair trade practices (FAO, 2025).

Several key international standards and best practices include:

1. **Hazard Analysis and Critical Control Points (HACCP)**: HACCP is a systematic preventive approach to food safety that identifies, evaluates, and controls hazards throughout the food production process (NASA, 2020). It is widely adopted globally and forms the basis for many national food safety regulations (FAO, 2025).

2. **ISO 22000**: This international standard specifies requirements for a food safety management system, integrating the principles of HACCP and ensuring food safety across the entire supply chain (ISO, 2025). ISO 22000 is recognized worldwide and helps organizations demonstrate their commitment to food safety (ISO, 2025).

3. **Global Food Safety Initiative (GFSI)**: GFSI benchmarks food safety standards globally, ensuring that certified standards meet rigorous requirements for food safety management systems (SGS, 2022). GFSI-recognized schemes include BRCGS, FSSC 22000, IFS Food, and SQF Code, which are widely adopted by food manufacturers and retailers (SGS, 2022).

4. **European Food Safety Authority (EFSA)**: EFSA provides scientific advice and support for EU legislation and policies on food safety, ensuring a high level of consumer

protection (EFSA, 2025). The EU's General Food Law Regulation (EC/178/2002) mandates traceability and risk analysis across the entire food supply chain (European Commission, 2025).

5. **Food Safety Modernization Act (FSMA)**: In the United States, FSMA focuses on preventing food safety issues rather than responding to them, enhancing the capacity to detect and respond to food safety problems (FDA, 2025). FSMA represents a significant shift towards proactive food safety management (FDA, 2025).

These global standards and best practices provide a structured framework for ensuring food safety, protecting public health, and facilitating international trade. By adopting and harmonizing these standards, countries can enhance their food safety systems, reduce trade barriers, and build consumer confidence in the safety and quality of food products.

2.2.2 Role of International Organisations, Treaties and Agreements

International organizations, multilateral treaties, and regional agreements play a foundational role in harmonising food safety standards and facilitating equitable trade practices**.** The Food and Agriculture Organization (FAO) and the World Health Organization (WHO) jointly administer the Codex Alimentarius Commission, a cornerstone institution in global food governance. Established in 1963, the Commission develops science-based food standards, guidelines, and codes of practice that serve as benchmarks for national regulatory frameworks. By 2023, the Codex had formulated over 200 standards covering food hygiene, labelling, additives, and contaminants, thereby reducing technical barriers to trade while safeguarding public health (Codex Alimentarius Commission, 2023). These standards are particularly critical for low- and middle-income countries (LMICs), which often lack the institutional capacity to independently develop rigorous food safety protocols.

The World Trade Organisation (WTO) further reinforces this framework through its Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement) and the Technical Barriers to Trade (TBT) Agreement. The SPS Agreement explicitly recognises Codex standards as the international reference for food safety, obliging WTO members to align their national

measures with these guidelines unless they can justify stricter regulations through scientific risk assessments. This dual mandate, protecting consumer health while preventing disguised trade restrictions, has been instrumental in resolving disputes, such as those involving meat hormone treatments and genetically modified organisms (GMOs) (FAO, 2017; WTO, 2017). The TBT Agreement complements this by addressing non-safety-related standards, such as packaging and labelling, ensuring transparency and proportionality in regulatory measures.

Regional agreements amplify global standards while addressing localised priorities. The European Union's General Food Law Regulation (EC/178/2002), for instance, enshrines the "farm-to-fork" principle, mandating traceability and risk analysis across the entire food supply chain. Similarly, the African Union's Sanitary and Phytosanitary (SPS) Policy Framework (2022–2032) seeks to harmonise food safety measures across member states, enhancing intra-regional trade and compliance with global standards. However, disparities persist in implementation capacity. For example, while the EU's Rapid Alert System for Food and Feed (RASFF) enables swift cross-border responses to food safety incidents, many LMICs lack analogous infrastructure, hindering real-time risk management (Le Vallée and Charlebois, 2015).

International non-governmental organizations (NGOs) also play a significant role in shaping food standards and policies**.** NGOs often advocate for higher safety and quality standards, conduct research, and provide technical assistance to countries (Food Safety Institute, 2024). Organizations like the International Food Safety Authorities Network (INFOSAN) collaborate with governments to set and enforce these standards, ensuring that food products are free from contaminants (WHO, 2024).

Quantifying the efficacy of food safety systems remains challenging due to the absence of universal metrics. The Global Food Security Index (GFSI), developed by the Economist Intelligence Unit, partially addresses this gap by evaluating national performance across four dimensions: availability; affordability; quality and safety; and sustainability. Within the "quality and safety" pillar, metrics include the comprehensiveness of food safety legislation, enforcement mechanisms, and responsiveness to emerging risks, such as antimicrobial resistance or climate-induced contamination (The Economist Intelligence Unit, 2022). The GFSI provides a

comprehensive framework for assessing food security and safety, highlighting areas for improvement and fostering international comparisons (Economist Impact, 2022).

Despite progress, fragmentation persists. Not all countries adopt Codex standards uniformly, and regional agreements occasionally diverge from global norms due to geopolitical or economic priorities. For instance, the United States and the European Union have different regulatory approaches to genetically modified organisms (GMOs), leading to trade disputes and regulatory inconsistencies (FAO, 2017). Moreover, emerging risks such as digital traceability, novel food technologies, and climate-related hazards demand agile governance frameworks. Digital traceability systems, powered by blockchain technology, can enhance transparency and accountability in food supply chains, but their implementation varies widely across countries (Zhou et al., 2021).

Strengthening multilateral collaboration, expanding funding mechanisms for LMICs, and developing dynamic, data-driven monitoring tools will be essential to bridging these gaps. Initiatives like the FAO/WHO International Food Safety Authorities Network (INFOSAN) exemplify progress, fostering real-time information sharing during food safety emergencies (WHO, 2017). INFOSAN's role in coordinating responses to food safety incidents underscores the importance of international cooperation in managing food safety risks (WHO, 2024).

Routine benchmarking evaluations of national food safety systems are important for fostering continuous improvement, accountability, and resilience in an increasingly interconnected global food supply chain. As nations strive to enhance their food safety preparedness and responsiveness, systematic assessments provide actionable insights into regulatory efficacy, infrastructural gaps, and adaptive capacities. Le Vallée and Charlebois (2015) underscore that such evaluations are not merely diagnostic tools but foundational to building proactive, science-driven governance frameworks capable of mitigating emerging risks, from zoonotic diseases to chemical contaminants. Benchmarking initiatives, such as those conducted by the Global Food Safety Initiative (GFSI), encourage the adoption of best practices and continuous improvement in food safety management systems (Kiwa, 2025).

2.3 Regional Perspective on Food Control at Borders

The African continent, characterised by diverse landscapes, cultures, and economies, presents a complex framework for food control at its borders. The region exhibits contrasts: countries such as South Africa, Egypt, and Côte d'Ivoire serve as net exporters of food, while others, including Nigeria, Angola, and Kenya, are heavily dependent on food imports such as dairy products, edible oils and fats, meat and meat products, sugars, and cereals, particularly wheat and rice, to meet domestic nutritional demands (FAO, 2019). Addressing these complexities requires a regional approach to food control, with harmonised policies that consider both common challenges and country-specific priorities.

The African Continental Free Trade Area (AfCFTA) aims to boost intra-African trade by reducing tariffs and non-tariff barriers, which can enhance food security and streamline food control measures across the continent (AfCFTA Secretariat, 2021). The AfCFTA is expected to increase intra-continental food trade by more than 60% by 2045, promoting regional cooperation and resilience in food supply chains (ECA, 2024).

However, food safety management across the continent is hindered by insufficient human and infrastructure capacity for official control, ineffective food monitoring and foodborne disease surveillance programs, limited expertise in food safety risk assessment, and inadequate laboratory services, among other deficiencies (African Union, 2021). The World Health Organization (WHO) estimates that the African region has the highest burden of foodborne diseases per population, with more than 91 million people falling ill due to contaminated food each year (WHO, 2025). This underscores the need for robust food safety systems and capacity-building initiatives.

Regional organizations such as the Intergovernmental Authority on Development (IGAD) and the Southern African Development Community (SADC) play crucial roles in coordinating food safety policies and initiatives. IGAD's efforts in crafting cohesive regional food security policies and coordinating cross-border initiatives to control livestock diseases exemplify the importance of regional cooperation (IGAD, 2025). Similarly, SADC's food safety strategy focuses on harmonizing standards and improving food safety infrastructure across member states (SADC, 2024).

Strengthening food safety systems in Africa requires investment in infrastructure, training, and technology. Enhancing laboratory capacities, improving food inspection services, and developing

effective foodborne disease surveillance programs are essential steps towards achieving food safety goals (AU-IBAR, 2025). Additionally, fostering public awareness and consumer engagement can help build a culture of food safety and support compliance with regulations (WHO, 2025).

2.3.1 The Regional Context

Food control systems in Africa are influenced by a combination of historical, economic, and infrastructural factors, including colonial legacies, economic inequalities, logistical constraints, and pressing food security demands across multiple regions. Current frameworks in many African nations remain fragmented, inadequately coordinated, and institutionally weak, limiting their capacity to safeguard consumer health and ensure the compliance of food exports with international standards (FAO, 2017). For instance, in Nigeria, despite being one of Africa's largest economies, food safety regulations are enforced by multiple agencies with overlapping mandates, leading to inefficiencies and gaps in oversight. Similarly, in Kenya, the lack of a unified food control system has resulted in inconsistent enforcement of safety standards, particularly in informal markets where the majority of food is traded. In Ethiopia, limited infrastructure and technical capacity hinder effective monitoring and regulation of food safety, particularly in rural areas where agricultural production is predominant. Additionally, in Malawi, weak institutional frameworks and insufficient funding for food safety agencies have constrained efforts to address contamination risks, such as aflatoxin in staple crops like maize. This systemic inefficiency poses significant challenges, particularly given the agricultural sector's central role in national economies, where both domestic food safety and export reliability are important for economic stability.

Intra-African trade remains limited, constituting only 10 to 20% of total trade volume, with sub-regional disparities evident: COMESA records 5%; ECOWAS and SADC 10%; and Central Africa below 2% (FAO, 2017). Concurrently, Africa's export challenges are amplified by stringent international regulations. Between 2008 and 2013, approximately 600 African food shipments were rejected at EU borders, representing nearly 30% of total EU import violations during this period (Kareem, Martínez-Zarzoso and Brümmer, 2023). Primary reasons for these rejections included non-compliance with EU regulations on mycotoxin and pesticide residue limits, reflecting systemic gaps in food safety practices (Ngum et al., 2022). Mycotoxin

contamination is a pervasive issue in the region, with sub-Saharan Africa disproportionately affected. High levels of dietary exposure to these toxins correlate with elevated rates of liver cancer, a public health crisis underscored by WHO estimates that over 500 million impoverished individuals, primarily in sub-Saharan Africa, are routinely exposed to unsafe mycotoxin concentrations (Ezekiel, Ortega-Beltran & Bandyopadhyay, 2019).

2.3.2 Significance and Implications of the African Continental Free Trade Area Agreement (AfCFTA)

The African Continental Free Trade Area Agreement (AfCFTA) is perhaps the most transformative proposed initiative. Envisioned as a game-changer, The AfCFTA was formally proposed in 2012 during the 18th African Union (AU) Summit in Addis Ababa, Ethiopia, as part of the broader Agenda 2063 framework. The AfCFTA seeks to create a single market for goods and services, facilitating the movement of business persons and investments across the continent (Charalambides and Capon, 2022). While the potential economic benefits are substantial, the Agreement also emphasises the importance of food safety.

For the vision of AfCFTA to be fully realised, member countries must ensure that their products, especially food, meet universally accepted safety and quality standards (Fofack, 2021). This necessitates robust food control systems at borders, harmonised regulations, and collaborative efforts to address shared challenges, such as transboundary pests or diseases to minimize food chain threats (Lele and Goswami, 2021). The Agreement's success will largely hinge on the delicate balance between promoting free trade and ensuring the safety and well-being of the African populace (Fofack, 2021).

2.4 Impact of aflatoxins on human health

The modern era of globalisation has rendered borders more porous than ever before, especially regarding the movement of goods and commodities. As an indispensable segment of this trade, food products present unique challenges and responsibilities for border control mechanisms. The safety of a nation's food supply is not just about domestic production but is intrinsically linked to the rigorous oversight at border checkpoints. Food inspectors at the border must be satisfied that each export or import product is free from the food mentioned above hazards as a prerequisite for granting market access (Kareem, Martínez-Zarzoso and Brümmer, 2023).

Aflatoxins, a group of highly toxic compounds produced by certain molds such as Aspergillus flavus and Aspergillus parasiticus, pose significant health risks to humans and animals alike (BiologyInsights, 2024). These toxins can contaminate a variety of food products, including cereals, nuts, and spices, and are particularly prevalent in regions with warm and humid climates (IntechOpen, 2021). Aflatoxin contamination is a persistent problem affecting global food security and safety, with the ability to cause severe health issues, including liver cancer and acute poisoning (BiologyInsights, 2024).

The mechanisms of aflatoxin toxicity involve their absorption in the gastrointestinal tract and subsequent metabolism in the liver, where they are converted into reactive intermediates. These intermediates can form adducts with DNA, leading to mutations and an increased risk of hepatocellular carcinoma (IntechOpen, 2021). Chronic exposure to aflatoxins through contaminated food can lead to a range of adverse health effects, including immunosuppression, stunted growth in children, and liver damage (MDPI, 2024).

The global impact of aflatoxin contamination has escalated due to its detrimental effects on human health and considerable economic losses. The economic burden includes reduced crop yields, increased healthcare costs, and trade restrictions (MDPI, 2024). Effective management of aflatoxin contamination requires a multi-faceted approach, including improved agricultural practices, rigorous food safety regulations, and advanced detection and prevention strategies (BiologyInsights, 2024).

Globalisation has further complicated the control of aflatoxin contamination, as food products often travel long distances and pass through multiple hands before reaching the consumer. This complexity necessitates robust food safety management systems that can ensure the safety of food products across international borders (Food Logistics, 2015). The Food Safety Modernization Act (FSMA) in the United States, for example, aims to enhance food safety by focusing on prevention and improving the capacity to detect and respond to food safety issues (Food Logistics, 2015).

a) **Linkage Between Border Control and Food Safety**

Border control is the first defence against potential food-borne threats entering a country. As countries increase their reliance on global supply chains to meet the dietary demands of their populations, the imperative for stringent border controls escalates (Mouzam, 2020). Every food

item crossing a border carries the cumulative safety practices, or lack thereof, from its origin. Effective border control mechanisms ensure that imported food products meet the same safety and quality standards as domestically produced ones, offering a level playing field for producers and ensuring consumers' health (ESCAP, 2018).

Zambia has multiple pieces of legislation that cover food safety, such as the Food Safety Act No. 7 of 2019 (National Assembly of Zambia, 2019), Public Health Act Cap 295, and the Animal Health Act No.24 of 2010 (National Assembly of Zambia, 2010). Strong food safety legislation is the backbone of the National Food Control System (NFCS), aiming for consumer protection from food-borne diseases (Shukla, Singh and Shankar, 2018). The Food Safety Act No. 7 of 2019 provides a comprehensive framework for regulating food safety, including the establishment of the Food Safety Coordinating Committee and the National Food Laboratory (National Assembly of Zambia, 2019).

A national food control system framework based on the FAO and WHO's guidelines covers the core elements: food control management; food legislation; food inspection; official food control laboratories; and food safety information, education, and communication (Shukla, Shankar and Singh, 2014). These guidelines emphasize the importance of a risk-based approach to food safety, ensuring that control measures are proportionate to the risks identified (FAO/WHO, 2013). Effective food control systems protect public health, facilitate fair trade practices, and enhance consumer confidence in the safety and quality of food products (FAO, 2025).

The World Health Organization (WHO) highlights the importance of harmonizing food safety measures with international standards to facilitate safe trade and protect public health (WHO, 2025). The Trade Facilitation Agreement, linked to the SPS Agreement, encourages countries to adopt science-based food safety measures and streamline border procedures to reduce delays and costs while maintaining high safety standards (WHO, 2025).

b) Consequences of Lapses in Border Food Control:

The ramifications of inadequate border food controls are profound and far-reaching. On a global scale, lapses can lead to widespread outbreaks of food-borne diseases. For instance, in 2011, a significant E. coli outbreak in Europe traced back to contaminated vegetable imports resulted in numerous deaths and thousands falling ill, causing panic and economic losses (Collignon, 2011).

Regionally, the introduction of the maize lethal necrosis disease was largely attributed to the import of contaminated seeds, which devastated maize crops in East Africa (Boddupalli *et al.,* 2020). Such incidents compromise public health, shake consumer confidence, disrupt trade relationships, and can lead to substantial economic repercussions.

Moreover, repeated lapses can result in long-term bans on certain products or from specific regions, affecting the livelihoods of countless farmers and producers. For instance, several Asian countries faced bans on their seafood exports to the European Union due to concerns over contamination and inadequate safety controls (Heinzler, Gerlach and Brunn, 2011). Evaluation of the European

Rapid Alert System for Food and Feed shows that health safety problems which in recent years have become rare in Europe are more common when dealing with food products imported from third world countries.

In essence, the robustness of border food control mechanisms is a testament to a country's commitment to safeguarding the health of its citizens, maintaining its international trade reputation, and ensuring economic stability.

2.5 Zambia's Position in Global and Regional Food Trade

Situated in the center of southern Africa, Zambia is positioned at the intersection of dynamic food trade movements, engaging both within the African continent and internationally. With its varied agricultural capabilities and increasing population, Zambia's involvement in the food trade is changing, shaped by internal factors as well as wider regional and global influences (Abrahams, 2010). In 2021, Zambia ranked 105th out of 113 countries on the Global Food Security Index (GFSI), with an overall score of 38, placing it among the world's ten worst-performing nations (The Economist Group, 2021). By 2022, its ranking improved slightly to 103, with an overall GFSI score of 43.5 out of 100 and a food quality and safety score of 56. These observations reflect gaps in regulatory modernisation, surveillance infrastructure and public-sector investment. Such rankings highlight the need for targeted technical assistance and capacity-building programs, particularly in regions where food safety systems lag behind trade liberalization efforts.

2.5.1 Zambia's Role in Food Trade - Global and Regional

While Africa as a continent is a significant player in the global food market, individual countries, including Zambia, have distinct profiles that reflect their unique geographical, economic, and socio-political realities (Manyeruke and Mhandara, 2013; Alford and Phillips, 2018). Though modest in scale, Zambia's participation in global food trade is vital for its economy. Regionally, its position in the Southern African Development Community (SADC) and the Common Market for Eastern and Southern Africa (COMESA) enhances its trade engagements with neighboring countries, fostering collaborations and partnerships (Bronauer and Yoon, 2018).

2.5.2 Food Import and Export Dynamics

A mix of subsistence farming and commercial agriculture characterizes Zambia's agricultural sector. While it produces substantial quantities of staple foods like maize, groundnuts and soybeans, the country heavily relies on imports for other commodities, including wheat, dairy products and some meats (Saasa, 2003).

Over the years, factors like fluctuating rainfall patterns, challenges in agricultural financing and pest infestations have sometimes constrained domestic production, necessitating increased imports to meet the country's food demands. On the export front, Zambia has carved a niche with products like honey and horticultural items, finding markets regionally and in parts of Europe (Hichaambwa, 2008; Meaton, Lowore and Wood, 2021). However, the overarching narrative is that Zambia remains a net food importer, with its import bill often surpassing its earnings from food exports. This dynamic presents economic challenges, especially given the volatility of global food prices and the country's limited diversification in its range of export products (Delgado, 1995).

2.6 Description of Zambia's Borders

Zambia has several key border posts that play a crucial role in its trade and food safety management. Notable border posts include:

- **Nakonde**: Located in the Muchinga Province, Nakonde is a major transit route for imports from East Africa, North Africa, the Middle East, and Asia. It handles around 800

trucks daily and is a significant revenue generator for customs operations (Ministry of Commerce, Trade and Industry, 2024).

- **Chirundu**: Situated on the Zambezi River, Chirundu connects Zambia with Zimbabwe and other Southern African countries. It was commissioned as a One-Stop Border Post (OSBP) in 2009 and is one of the busiest borders in Zambia (Ministry of Commerce, Trade and Industry, 2024).
- **Kazungula**: This border post connects Zambia with Botswana and features a multi-million dollar bridge that enhances trade and transport efficiency (Zambia Monitor, 2024).
- **Mwami**: Located near the border with Malawi, Mwami is another critical border post for regional trade (Ministry of Commerce, Trade and Industry, 2024).

2.6.1 Performance of the Coordinated Border Management

The performance of Zambia's border posts has seen significant improvements due to the implementation of the CBM system and enhanced inter-agency cooperation. For instance, the Time Release Survey conducted at Chirundu and Kazungula OSBPs revealed a 60 percent reduction in border clearance times for goods and travelers, from over 48 hours in 2022 to just under 14 hours in 2024 (Zambia Monitor, 2024). However, challenges such as infrastructure limitations and resource constraints still impact overall efficiency (National Assembly of Zambia, 2024).

2.6.2 Comparison with Other Countries' Borders

2.6.2.1 Global Comparison

Globally, countries like the United States and those in the European Union have advanced border management systems. For example:

- **United States**: The U.S. employs high-tech border security systems, including biometric identification, advanced cameras, and sensors to enhance border security and efficiency (IEEE, 2021).

- **European Union**: The EU's General Food Law Regulation mandates traceability and risk analysis across the entire food supply chain, supported by the European Food Safety Authority (EFSA) for scientific advice (European Commission, 2025).

2.6.2.2 Regional Comparison

Regionally, countries like South Africa and Kenya have also made significant strides in border management:

- **South Africa**: Utilizes advanced inspection equipment and has implemented the Single Window System to streamline customs procedures (OECD, 2024).
- **Kenya**: Has invested in modern border infrastructure and ICT systems to enhance trade facilitation and border security (OECD, 2024).

2.6.3 Systems Involved

Zambia's border posts are equipped with systems such as the Coordinated Border Management (CBM) system, which integrates the operations of various border agencies to streamline processes and reduce delays. The CBM system is currently being piloted at Kazungula and Chirundu OSBPs, reducing the number of border agencies to six: Zambia Revenue Authority (ZRA), Immigration Department, Zambia Compulsory Standards Agency (ZCSA), Port Health, National Livestock Epidemiology Information Centre (NALEIC), and Plant Quarantine and Phytosanitary Services (PQPS) (Ministry of Commerce, Trade and Industry, 2024).

2.6.4 Connectivity in Systems, Protocols, and Infrastructure

2.6.4.1 System Connectivity

Zambia's border systems are increasingly connected through initiatives like the CBM system, which is being piloted at Kazungula and Chirundu OSBPs. This system reduces the number of border agencies to six, enhancing coordination and efficiency (Ministry of Commerce, Trade and Industry, 2024). The introduction of high-speed internet connectivity at key border posts, such as Chirundu, Mwami, Chanida, Kasumbalesa, and Katima Mulilo, further supports streamlined border processes (SMART Zambia Institute, 2024).

2.6.4.2 Protocols and Infrastructure

Protocols for food safety inspections and customs procedures are aligned with international standards, such as those set by the Codex Alimentarius. Infrastructure developments, such as the construction of modern inspection bays and cold storage facilities, are crucial for effective border management (NEPAD, 2024). The use of ICT infrastructure, supported by initiatives like the AUDA-NEPAD Trade Facilitation and Logistics Program, enhances border connectivity and efficiency (NEPAD, 2024).

2.6.5 Training and Technological Challenges

Ensuring that every piece of food crossing a border is safe demands rigorous training and updated technological tools. However, in many regions, the training of border personnel is not consistent or up-to-date with global best practices, leading to potential gaps in inspection (IEEE, 2021). Technological challenges, such as outdated inspection equipment or a lack of digital record-keeping systems, further exacerbate these issues (PwC, 2025). High-tech border security systems, including biometric identification and artificial intelligence, are revolutionizing border surveillance but require proper training and regulation to be effective (IEEE, 2021).

2.7 Incidents and Case Studies: Zambia's Food Recall Chronicles

Ensuring the safety of imported food is a global concern, and Zambia, as a hub of both regional and international trade, has witnessed its share of challenges. An analysis of past incidents related to food recalls in the country offers a profound insight into the broader intricacies of border food control, the ramifications of lapses, and the lessons learned.

2.7.1 Incidents of Unsafe Food Imports

The recent past has seen a series of alarming recalls, indicative of the vulnerabilities within Zambia's food import control mechanisms:

i. **Pioneer Foods and Ceres Apple Juice recall in October 2021**: South African food and beverage giant Pioneer Foods initiated a recall of its Ceres apple juice brands sold across seven COMESA markets, including Zambia. These products contained elevated patulin levels, a mycotoxin with severe health implications, leading to nausea, vomiting, and gastrointestinal disturbances (Lusaka Times, 2021; Pioneer Foods, 2021). Patulin is a naturally occurring mycotoxin commonly found in apple

juice concentrate and apple juice, and its presence exceeding regulatory thresholds necessitated the recall (Pioneer Foods, 2021).

ii. **Appletiser Sparkling Apple Juice recall in September 2021**: A parallel incident saw the recall of Appletiser sparkling apple juice manufactured by the Coca-Cola South Africa Company. The recall was instigated by elevated patulin levels, surpassing the permissible fifty parts per billion (50 ppb) for foodstuffs, a situation alarming enough for the COMESA Competition Commission to intervene (CCPC, 2021; Coca-Cola, 2021). The elevated levels of patulin posed significant health risks, including gastrointestinal disturbances (Daily Mail, 2021).

iii. **Tiger Brands Vegetable Products recall September 2021**: Further incidents in the same month spotlighted the recall of Tiger Brands' KOO and Hugo branded vegetable products imported from South Africa. The issue centred around a cold weld seam defect, making these products susceptible to microbial contamination (CCPC, 2021; News24, 2021). The recall affected approximately 20 million cans due to potential health risks associated with defective packaging (News24, 2021).

iv. **Processed Meat Recall in 2018**: This year saw an extensive recall of South African processed meat products, notably from Tiger Brands and Rainbow Chicken, following a deadly listeria outbreak that had dire consequences in South Africa (Lusaka Times, 2018; CDC, 2018). The outbreak resulted in significant public health concerns and highlighted the importance of stringent food safety measures (CDC, 2018).

v. **Lyons Peanut Butter in 2016:** Highlighting the risks of contamination, the Zambia Bureau of Standards seized significant quantities of Lyons peanut butter imported from Zimbabwe after tests revealed dangerous levels of aflatoxins, potent carcinogens known to cause liver damage (Lusaka Times, 2016; Food Poisoning Bulletin, 2016). Aflatoxins are produced by certain molds and can contaminate a wide range of food products, posing serious health risks (Food Poisoning Bulletin, 2016).

vi. **Zambeef Beef Products recall 2013:** Zambeef, a major player in Zambia's food industry, was compelled to recall its imported beef products amidst concerns over excessive chemical levels, specifically formaldehyde (ENCA, 2013). Formaldehyde, a chemical used in embalming, was found in offals and hooves imported from Europe, posing significant health risks including cancer and respiratory issues (Medical Xpress, 2013).

2.7.2 Implications, Responses and Lessons Learned

The aftershocks of such recalls are multi-faceted. Beyond the immediate health risks, they erode public trust, disrupt trade relations, and pose economic challenges (Tembo & Sikazwe, 2019). The silver lining, however, has been the heightened vigilance and collaborative responses among regulatory agencies. Measures like countrywide surveillance exercises, increased laboratory testing, and reinforced inter-agency coordination have been implemented. Yet, as these incidents underline, the journey to ensuring impeccable food safety standards remains ongoing, demanding continuous monitoring, adaptability, and public awareness campaigns (Sikombe & Kapata, 2020).

2.8 Stakeholder Engagement in Food Control

In food control, particularly at critical junctures like borders, the stakeholders' diversity cannot be overstated. These stakeholders, ranging from government agencies to private entities, play pivotal roles, weaving a tapestry of checks and balances essential for ensuring the safety and quality of food products.

2.8.1 Role of Various Stakeholders

Government Agencies: At the forefront are the government agencies, each bringing a specific expertise. For instance:

i. Department of Veterinary Services (DVS) under the Ministry of Fisheries and Livestock focuses on ensuring the health of animals and the safety of animal products.
ii. Plant Quarantine and Phytosanitary Services (PQPS) in the Ministry of Agriculture concerns itself with preventing the introduction and spread of pests and diseases in plants.

iii. The Port Health under the Ministry of Health oversees the broader health implications of the food items, ensuring they meet health and safety standards.
iv. Zambia Compulsory Standards Agency (ZCSA) in the Ministry of Commerce, Trade, and Industry ensures compliance with established national standards.

Private Players: The private sector brings a unique perspective, often grounded in the practicalities of trade and commerce. Key entities like the Zambia Export Growers Association (ZEGA) offer insights into the challenges and nuances of the export dynamics, while the Zambia Association of Manufacturers (ZAM) represents a broad spectrum of producers crucial for both the domestic and international markets.

2.8.2 Significance of a Participatory Approach

Given the diverse stakeholders, the importance of a participatory approach in food control cannot be overemphasised. This approach ensures comprehensive insights, fosters collaborative problem-solving, and streamlines communication channels.

The dynamics at border posts like Chirundu OSBP and Nakonde OSBP. A coordinated, participatory approach is indispensable with multiple agencies - 15 for Chirundu and 11 for Nakonde, as highlighted in the Time Release Studies (TRS). As seen in the TRS, mapping stakeholders based on their interests and influence ensures that each agency's concerns and expertise are acknowledged and integrated, creating a more holistic and efficient food inspection process (MCTI and ZRA, 2022).

2.9 Traceability and Food Safety

In the twisting world of modern food production and distribution, traceability has emerged as a paramount instrument for ensuring food safety. It offers a lifeline that can trace a product's journey from farm to fork, ensuring transparency, accountability, and, most importantly, consumer safety.

2.9.1 Importance of Traceability in Ensuring Food Safety

i. Accountability: Traceability establishes a clear line of responsibility throughout the food supply chain. It ensures that every entity involved - from farmers to retailers - is accountable

for the safety and quality of the products they handle. The availability of internal traceability is one of the elements of an effective traceability system (Zhang and Bhatt 2014).

ii. Rapid Response: When food safety issues arise, traceability systems enable rapid identification of the source of the problem, facilitating timely recalls and minimising potential health risks. The objective of traceability is to quickly identify the source of a food safety problem and take the steps necessary to withdraw or recall a food product from the market with minimal interference in production (World Bank, 2019).

iii. Consumer Confidence: In an era where consumers are increasingly concerned about the provenance and safety of their food, traceability offers transparency, bolstering consumer trust and confidence in the food supply chain. The experience of other countries shows that companies with a high level of consumer confidence usually remain highly competitive in the global markets (World Bank, 2019).

v. Regulatory Compliance: With regulations around food safety becoming increasingly stringent globally, traceability systems ensure that businesses remain compliant, avoiding potential legal and financial repercussions. According to ISO 22005:2007, traceability systems support food safety objectives and fulfil applicable local, regional, national, or international regulations or policies (ISO, 2007).

2.9.2 Current Practices, Challenges, and Innovations in Traceability

Practices: Current traceability practices often involve a combination of manual record-keeping and digital systems, tracking products through barcodes, QR codes, or RFID tags. These systems capture data at every stage, from production to distribution. Manufacturing companies need to record key data and parameters throughout the production process while ensuring that all records are actual, reliable and enable efficient food traceability at every step of the production chain (World Bank, 2019; Food Standards Agency, 2019).

i. Challenges: Despite advancements, challenges persist. These include the inconsistency of traceability practices across regions, the high cost of implementing advanced traceability systems, especially for small-scale producers, and concerns about data privacy and security.

The bulk of the domestic food trade in Africa occurs via informal supply chains (Onyeaka et al., 2013).

ii. Innovations: Technological advancements are continuously reshaping the landscape of traceability, especially in the agri-food supply chains, which are complex and involve a large number of actors — from small-scale farmers, primary processors, and traders to product manufacturers, distributors, retailers, and consumers (UNDP, 2021). Blockchain technology, for instance, offers an immutable (Reyna et al., 2018), transparent and accountable (Tama et al.,2017; Kshetri, 2018), and decentralised ledger, ensuring enhanced security (Galvez et al., 2018) and transparency in food traceability. Additionally, the advent of smart sensors and Internet of Things (IoT) devices provide real-time data monitoring, further enhancing traceability practices (Zhang et al., 2017).

2.10 Gaps in Current Knowledge and Practice

The food control system, particularly at national borders, is ceaselessly evolving, driven by emerging threats, global trade dynamics, and technological advancements. While substantial progress has been made in shaping and refining these controls, there remain pronounced gaps in our knowledge and practice that demand attention. Areas requiring further research and attention include:

i. **Emerging Contaminants**: New contaminants and residues in food, from microplastics to novel pesticides, are continually being identified. The potential health implications of these contaminants, especially in the long term, necessitate further research (Aransiola et al., 2024).

ii. **Climate Change and Food Safety**: The impacts of climate change on food safety, from changing patterns of food-borne diseases to introducing new pests and diseases, are not fully understood. This intersection warrants deeper exploration (Smith et al., 2018).

iii. **Technology and Food Control**: As technological tools become more sophisticated, their applications and implications for food control need continuous evaluation. This includes

understanding the potentials and limitations of tools like blockchain in traceability or AI in risk assessment (Jones, 2025).

iv. **Informal Trade Channels**: Much of the food trade, particularly in African regions, operates through informal channels. These channels, often overlooked, pose unique challenges and risks regarding food control (Onyeaka et al., 2021).

v. **Comprehensive Evaluations of Zambia's Border Food Control Systems**: One glaring gap in current understanding is the scarcity of comprehensive evaluations of Zambia's border food control systems. While fragmented assessments might exist, a holistic evaluation encompassing all border posts, agencies involved, and diverse types of food imports seems to be missing (Business Regulatory Review Agency, 2023).

With its strategic position and role in regional food trade, Zambia demands a robust and efficient border food control system. The lack of detailed evaluations means that policy decisions may be based on incomplete or outdated information, potentially compromising the safety and quality of imported foods (Office of the Vice President, 2019). Currently, Zambia does not have a food safety policy or food safety strategy; however, suffice it to say that there are available legislative policy measures like the Food and Nutrition Act, the Competition and Consumer Protection Act, and the Animal Health Act that restrict the sale of unsafe food (National Food and Nutrition Commission, 2020). A further review of the two long-term national planning documents, namely the Vision 2023 and the eighth national development plan (8NDP), revealed that food safety was not directly mentioned therein (World Food Programme, 2023).

Furthermore, as Zambia navigates its position within the evolving landscape of the African Continental Free Trade Area Agreement (AfCFTA), clearly understanding its border food control systems' strengths and weaknesses becomes even more imperative (African Union, 2020).

Several salient themes emerge as we traverse the vast landscape of border food control. The intricate dance between food trade and safety underpins global and regional economies, with international organisations, treaties, and agreements shaping the narrative. Regions like Africa and nations such as Zambia face unique challenges – from the overarching dynamics of the

African Continental Free Trade Area Agreement (AfCFTA) to the nitty-gritty of daily operations at specific border posts like Nakonde and Chirundu (Fusacchia et al., 2022).

Through the lens of the literature, we discern the significance of stakeholder engagement, with diverse entities from government agencies to private players collaboratively sculpting food control measures (Ngoma, 2017). Traceability emerges as a non-negotiable pillar in the food safety paradigm, with technological innovations promising to redefine its future (Patel, 2019). Yet, the landscape is punctuated with gaps in our knowledge, practices, and, notably, in comprehensive evaluations of Zambia's border food control systems (Business Regulatory Review Agency, 2023).

In seeking to design a risk-based food control border framework for Zambia, focusing on the Nakonde and Chirundu one-stop border posts, this study endeavours to address existing gaps, refine prevailing practices, and contribute a fresh perspective (Chileshe, 2023). Positioned at this intersection of global, regional, and local contexts, the research promises to enhance Zambia's food control measures and enrich the broader dialogue on food safety in an interconnected world.

CHAPTER THREE
METHODOLOGY

3.1 Study area

Chirundu (Zambia/Zimbabwe) and Nakonde (Zambia/Tanzania) were strategically chosen from among the five critical borders highlighted in a Euro 48 million EU-COMESA Trade Facilitation Programme. Their selection was based on their key roles in advancing trade corridor and border management improvements, aiming to bolster regional trade and economic growth (Zambia Statistical Agency, 2022).

Nakonde One Stop Border Post, located in Muchinga province's Nakonde district with an estimated population of 178,788 (Zambia Statistics Agency, 2022), is a crucial economic hub on the Dar-es-Salaam trade corridor. It handles an average of 750 trucks daily and ranks as the highest port of entry by traffic volumes of trucks cleared, accounting for 19.20% of total volumes (MCTI and ZRA, 2022). The Nakonde OSBP has undergone significant upgrades, including improved infrastructure, enhanced digital trade processes, and reduced truck dwell times, which are anticipated to boost economic growth and regional trade (MCTI and ZRA, 2022; EU-COMESA, 2022).

Chirundu One Stop Border Post, situated in Southern province's Chirundu district with a population of 78,780 (Zambia Statistics Agency, 2022), serves as a critical junction on the North-South corridor, the busiest regional transit link in Eastern and Southern Africa. It ranks as the second highest port of entry by traffic volumes of trucks cleared, accounting for 18.23% of total volumes (MCTI and ZRA, 2022). Commissioned as a One Stop Border Post in 2009, Chirundu has faced operational challenges but continues to be a vital transit route, generating significant revenue and facilitating trade between Zambia and neighbouring countries (Zambia Statistical Agency, 2024; IOM, 2025).

In 2021, Nakonde and Chirundu together accounted for more than 46% of total revenue collection, with Chirundu being the highest ranked port of entry (28.5% of total revenue collected) and Nakonde being the third highest ranked port of entry (17.6% of total revenue collected). The border posts are connected by the T2 trunk road, part of the Great North Road, which is arguably Zambia's most crucial economic roadway. Road transport, as the dominant

mode of trade transportation for both imports and exports, represents over 50% of trade value (Zambia Statistics Agency, 2024; Cheruiyot, 2018)

3.2 Study design

The case study design was chosen for its ability to provide a detailed and contextualized understanding of complex phenomena, particularly in the field of food safety and border control (Yin, 2018). Case studies are effective in exploring the nuances of specific contexts, allowing for a comprehensive examination of the factors influencing the development and implementation of the risk-based food control framework (Stake, 1995). This approach is supported by recent research that emphasizes the importance of case studies in understanding the dynamics of food safety management at border points (Li-Ya Wu, 2021). Additionally, critiques of study design in border food control highlight the need for robust methodologies that can address the multifaceted challenges of food safety and trade (Wang, 2024).

3.2.1 Data Collection Methods

Data collection methods included comprehensive key informant interviews, purposively sampled to ensure information-rich contributions. These interviews targeted stakeholders such as border officials, traders, and representatives from SPS agencies, providing diverse perspectives on the current food control practices and challenges (Creswell, 2018). Additionally, participatory focus group discussions were conducted during two intensive five-day workshops. The workshops employed a domain-specific, interactive format to facilitate scenario analyses and collaborative discussions (Ørngreen, 2017). This format allowed participants to engage in real-time problem-solving and share their experiences, fostering a collaborative environment for generating practical solutions.

3.2.2 Data Analysis

Collected data, including transcripts from interviews, flip charts, and field notes, were organized using QDA Miner, a qualitative data analysis software (QSR International, 2020). The data were analyzed thematically to identify recurring patterns, strengths, weaknesses, and opportunities for a more effective risk-based food control framework. The thematic analysis involved coding the data to categorize key themes and sub-themes (Braun, 2006), which were then systematically

reviewed to ensure consistency and accuracy. This process enabled the identification of critical insights into the operational and infrastructural aspects of the border food control systems, as well as the institutional challenges faced by stakeholders.

3.2.3 Enhancements

To enhance the robustness of the study, triangulation was employed by cross-verifying the findings from different data sources and methods. This approach ensured the reliability and validity of the results, providing a comprehensive understanding of the framework's implementation and impact. Furthermore, the study incorporated feedback loops, where preliminary findings were shared with participants for validation and refinement. This iterative process helped in refining the framework and ensuring its relevance and applicability to the local context..

3.3 Sampling size and frame

Firstly, the participants were selected through purposive criterion sampling to ensure the inclusion of individuals who could provide "information-rich data" (Creswell and Poth, 2016). This technique, also known as judgmental sampling, is particularly effective when dealing with smaller sample sizes typical of case study research (Saunders, Lewis, and Thornhill, 2009). Purposive sampling is widely recognized for its ability to identify and select information-rich cases related to the phenomenon of interest, making it a valuable strategy in qualitative research (Palinkas et al., 2015).

The sample size for key informant interviews comprised 20 individuals as higligted in Table 3.1, while the workshops involved two groups with a minimum of 35 and a maximum of 39 participants each, as highlighted in Table 3.2. The institutions from which the participants were drawn were identified through the reports of the Time Release Studies for Chirundu (MCTI and ZRA, 2019) and Nakonde (MCTI and ZRA, 2022). Time Release Studies are strategic tools used to measure border clearance efficiency by tracking the time taken for goods to move through customs processes, thereby identifying key institutions involved in border management (World Customs Organization, 2018).

Sampling for key informant interviews was guided by the principle of data saturation, which emphasizes that data collection continues until no new relevant information emerges (Braun and

Clarke, 2021). Data saturation is a critical concept in qualitative research, ensuring that the sample size is sufficient to capture the full range of perspectives and experiences relevant to the study (Saunders et al., 2018). This principle is rooted in grounded theory and is widely accepted as a methodological standard in qualitative research (Glaser and Strauss, 1967).

Statistical models for sample size were not required, as the focus was on achieving depth and richness of data rather than statistical generalizability (Braun and Clarke, 2021). This approach aligns with the qualitative research paradigm, which prioritizes the quality and depth of insights over the quantity of data points (Fusch and Ness, 2015).

Table 3.1: Distribution of Key Informants at Chirundu Border Post According Gender

Key informant	**Female**	**Male**	**Subtotal**
Clearing Agents (Food commodities)	2	2	4
Department of Veterinary Services	2	0	2
Plant Quarantine and Phytosanitary Service	0	3	3
Port Health	2	4	6
Zambia Compulsory Standards Agency	1	4	5
Total	**7**	**13**	**20**

Table 3.2: List of Workshop Participants at Chirundu and Nakonde Border Posts

Participant representation	**Number of workshop participants**			
	Chirundu		**Nakonde**	
	April 2022	**May 2022**	**April 2022**	**May 2022**
Ministry of Commerce Trade and Industry	5	6	3	7
Ministry of Fisheries and Livestock	5	5	5	5
Ministry of Local Government (Local authorities)	4	0	2	1
Plant Quarantine and Phytosanitary Service	6	5	5	7
Ministry of Health (Port Health)	14	14	11	11
University of Zambia	2	1		1
Zambia Compulsory Standards Agency	3	2	3	1
Zambia Police	0	0	1	1
Zambia Revenue Authority	0	1	2	1
Total	**39**	**34**	**32**	**35**

3.5 Planning and Organization of Workshops

As a first step in conducting the workshop, the prescriptions of the Dutch facilitator, Jac Geurts were followed, where he stated that a workshop requires "3Ps", or "Proper Prior Planning", for its successful implementation (Inmark, 2010, p.6). Over a four-week period, meticulous planning was undertaken to facilitate successful meetings. Logistics were arranged, agendas were developed based on established frameworks, and stakeholders were identified and invited through gatekeepers. Constant engagement with gatekeepers ensured effective communication and coordination, crucial for mobilizing stakeholders dispersed across different locations. Workshops can be optimised as a qualitative approach for data collection by planning the

activities and creating an environment such that the participants could collaborate and interact without any hesitation (Inmark, 2010).

3.6 Facilitation Team Composition and Roles

The facilitation team, consisting of four members, played a pivotal role in orchestrating the meetings. Comprising senior officers from relevant government departments and experienced academics, the team liaised with gatekeepers to ensure smooth implementation of the research process. The facilitation team was drawn from the following institutions; Department of Veterinary Services, Ministry of Health, Plant Quarantine and Phyosanitary Service and the University of Zambia.

3.7 Room Preparation and Participant Registration

On the day of the meetings, the room was set up and participants were registered. Gatekeepers facilitated registration and arranged seating in a U-shape. The U-shape seating arrangement was adopted to enhance participant interaction by ensuring that everyone has a clear view of the facilitator and each other, which fosters active discussion and collaboration. Figure 3.1 one shows a pictorial impression of the seating arrangement before participants settled in.

Figure 3.1: Horseshoe type of seating that allows for optimum interaction between the facilitator and the participants.

3.8 Introduction and Agenda Setting

The meetings commenced with personal introductions, acknowledging cultural norms regarding the use of surnames. After setting the purpose and methodology of the meetings, stakeholders' expectations were discussed and assessed, fostering engagement and alignment of objectives. As facilitators, we began the first workshop with an icebreaking session after which we conducted a mini-lesson (Bennett, 2007) where we asked the participants to describe their roles in food control systems. This is very important in the sense that the participants must feel that they have something to learn from the workshop and enjoy being a part of it. Otherwise, they will not be involved in it wholeheartedly, and thus would provide only poor data for the researchers (Ahmed and Asraf, 2018). The value of participatory research comes from authentic collaboration, and achieving authentic collaboration requires that workshop participants be treated as partners (Binet etal, 2019).

3.9 Identification of Most Traded Food Commodities

Stakeholders collaboratively identified high-importance food commodities and their associated inspection procedures, laying the groundwork for subsequent discussions on risk assessment and categorization. High importance food commodities are defined as those that are traded frequently, represent significant economic value, and carry substantial food safety risk. Their classification was determined through stakeholder input during the workshops, which considered factors such as trade volume, revenue contribution and the potential impact on public health. Following group presentations, plenary sessions were conducted to synthesize key insights and facilitate knowledge exchange among participants. Figure 3.2 highlights the commonly traded food commodities of high interest to the Zambia Compulsory Standards Agency.

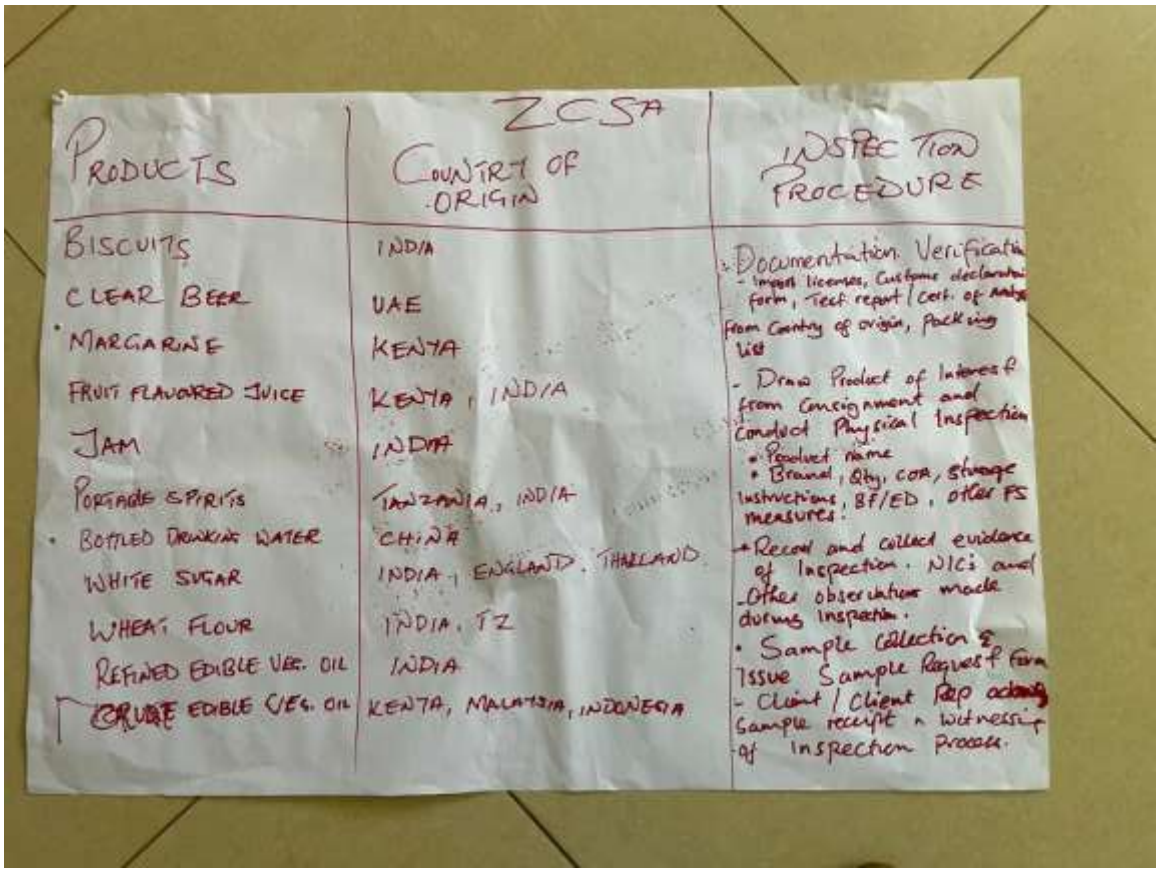

Figure 3.2: List of most traded imported food commodities identified by Zambia Compulsory Standards Agency

3.10 Risk Categorization of Traded Commodities

Groups reconvened to qualitatively assess and categorize identified commodities based on risk levels, promoting a nuanced understanding of potential hazards within the food supply chain. Figure 3.3 shows a qualitative risk assessment under taken by Ministry of Fisheries and Livestock.

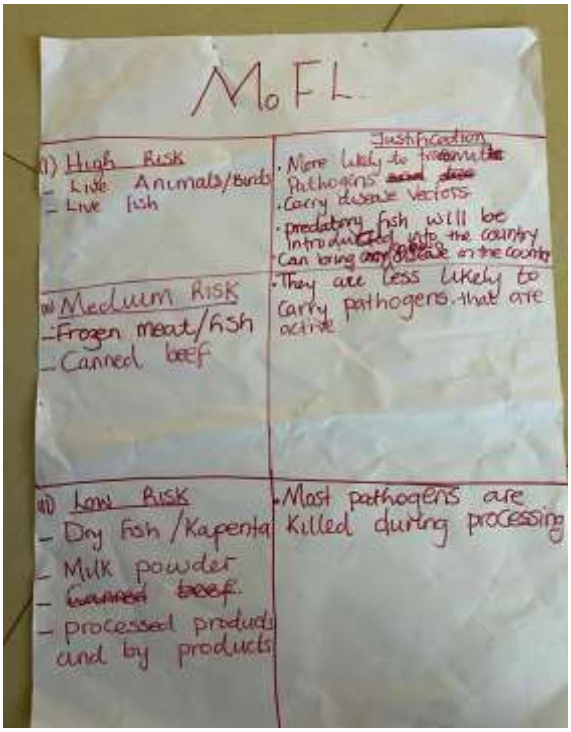

Figure 3.3: Qualitative Risk Assessment Undertaken by the Ministry of Fisheries and Livestock

3.11 Scenario Analysis and Challenges Identification

Participants engaged in scenario analysis to identify operational challenges encountered during border inspections, fostering a proactive approach to risk mitigation. The agencies were asked to identify and discuss the challenges that might significantly hamper their operational efficiency. Figure 3.4 below shows two flip charts sheets presented by PQPS and ZRA respectively.

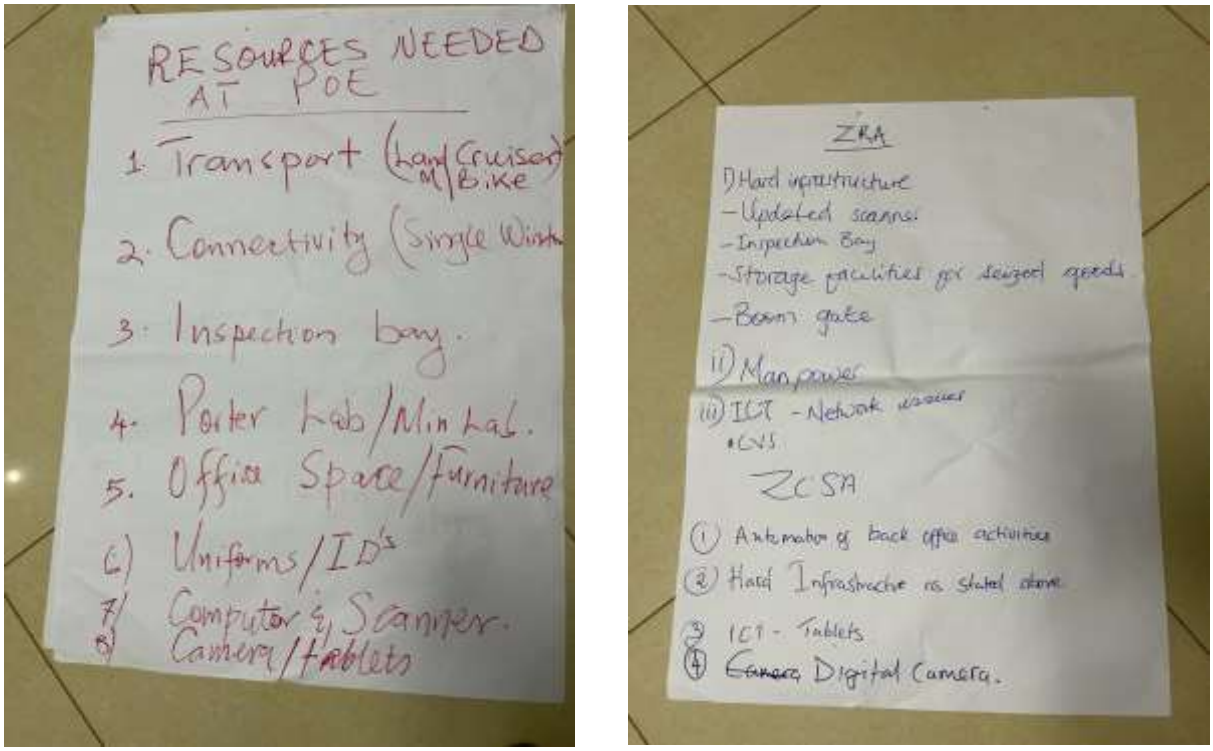

Figure 3.4: Resources needed to address operational challenges as identified by Plant Quarantine and Phytosanitary Service (PQPS) and Zambia Revenue Authority (ZRA).

3.12 Consolidation Meeting and Cross-Border Insights

A virtual consolidation meeting was convened via ZOOM™ to integrate and harmonize findings from both the Chirundu and Nakonde districts. During this meeting, representatives from various border agencies and stakeholder groups reviewed and compared the data collected in the respective study areas, facilitating the identification of common challenges and gaps in border control processes. The session enabled a cross-border dialogue, fostering an understanding of shared operational issues and paving the way for unified recommendations.

3.13 Development and Validation of Risk-Based Framework

Based on the challenges identified during the consolidation meeting and subsequent workshops, a risk-based inspection manual was collaboratively developed. Facilitators and stakeholders engaged in iterative discussions to co-create solutions tailored to the operational realities at the

border posts. The development process involved mapping identified risks to targeted mitigation strategies, which were then validated through further workshop sessions and stakeholder feedback. This collaborative approach ensured that the framework was comprehensive, practical and responsive to the dynamic risk environment at the border.

3.14 Review and Validation of Standard Operating Procedures

Draft standard operating procedures were prepared and circulated among key border agencies for an extensive review. This review process included structured feedback sessions, during which border agency representatives and other stakeholders evaluated the procedures for alignment with actual operational practices. The iterative review and validation process allowed for adjustments based on practical insights and regulatory requirements, thereby enhancing the relevance, clarity, and implementability of the SOPs for food control at the border posts. The SOPs were developed through a collaborative process involving a task force comprising representatives from key border agencies such as the Zambia Revenue Authority and the Ministry of Commerce, Trade and Industry as well as other relevant stakeholders. These procedures were sourced from a combination of international best practices and national regulatory guidelines, then adapted to address local operational realities.

3.15 Key Informant Interviews for Data Validation

Key informant interviews were conducted at the border to validate collected data and cross-check workshop insights. Permission to conduct research at Chirundu Border Post was obtained through a courtesy call to the Assistant Commissioner Customs. Introductory visits at targeted agencies included providing participant information sheets, interview guides, and informed consent forms. Interviews followed the sequence outlined in Appendix 2, with additional confirmatory and exploratory questions as needed, and data were recorded via note-taking.

3.17 Data Quality Assurance

Interviews were conducted, transcribed, and analyzed by one person to minimize data discrepancies, ensuring consistency in interpretation. Thematic analysis was employed to

identify common patterns and insights within the collected data. It mainly involved identification of themes through careful reading and re-reading of the transcribed data (King, 2004; Rice & Ezzy, 1999). Quality assurance measures, including verification of documented information by the principal supervisor, were rigorously implemented to uphold data integrity and reliability as show in Figure 3.5 below.

Figure 3.5: Data quality assurance after the transcription process prior to coding.

3.18 Data Analysis and Thematic Development Process

3.18.1 Data Organization and Familiarization (Phase 0ne)

The flip charts generated during the workshops in Chirundu and Nakonde were secured and later transcribed for further analysis. Additionally, field notes from key informant interviews were compiled and transcribed, facilitating a comprehensive understanding of the collected data. All the transcripts were transferred into QDA Miner for the analysis. Familiarization with the data was achieved through a thorough review of documented information, allowing for the

identification of recurring themes, patterns, and interesting observations. During the review of the transcripts, all noteworthy information was emphasized. Table 3.3 shows a total of 262 points of interest identified and cross-checked with the Research Objectives/Questions. The primary goal of this comprehensive data examination was to gain a deep understanding of the entire dataset and gather preliminary points of interest, as Chamberlain (2015) notes.

Table 1.3: Points of Interest generated from the codes under the themes

Categories	Codes	Counts	Counts %	Cases	Cases %
AS IS SCENARIO	Strengths of Food Controls	45	17.20%	8	100.00%
	Weaknesses of Food Controls	37	14.10%	6	75.00%
TO BE SCENARIO	Proposed Solutions	51	19.50%	7	87.50%
	Process Compromise	9	3.40%	3	37.50%
	Benchmarking	7	2.70%	4	50.00%
GAP ANALYSIS	Involvement	13	5.00%	6	75.00%
	Information Exchange	30	11.50%	8	100.00%
	Infrastructure Challenges	40	15.30%	6	75.00%
	Hunan Resources Issues	6	2.30%	5	62.50%
	Process Inefficiencies	24	9.20%	7	87.50%
Total count of points of interest		262			

3.18.2 Generating Initial Codes (Phase two)

The coding process commenced with the manual assignment of codes that ranged from single word, phrases and short sentences data, highlighted the depth of the early findings. Recognizing the critical need for thorough transcript review prior to code generation, the researcher meticulously reread and coded all the data, resulting in a sufficient number of codes (n=10) as shown in Figure 3.6 below. The use of QDA Miner's efficient coding feature facilitated the application of multiple codes by selecting relevant phrases or sentences/paragraphs. This approach enabled the uncovering of broader themes and concepts, facilitating the identification of similarities, differences, and relationships between and within the borders studied. A thorough thematic analysis method can yield meaningful and reliable results (Nowell, Norris, White, and Moules, 2017).

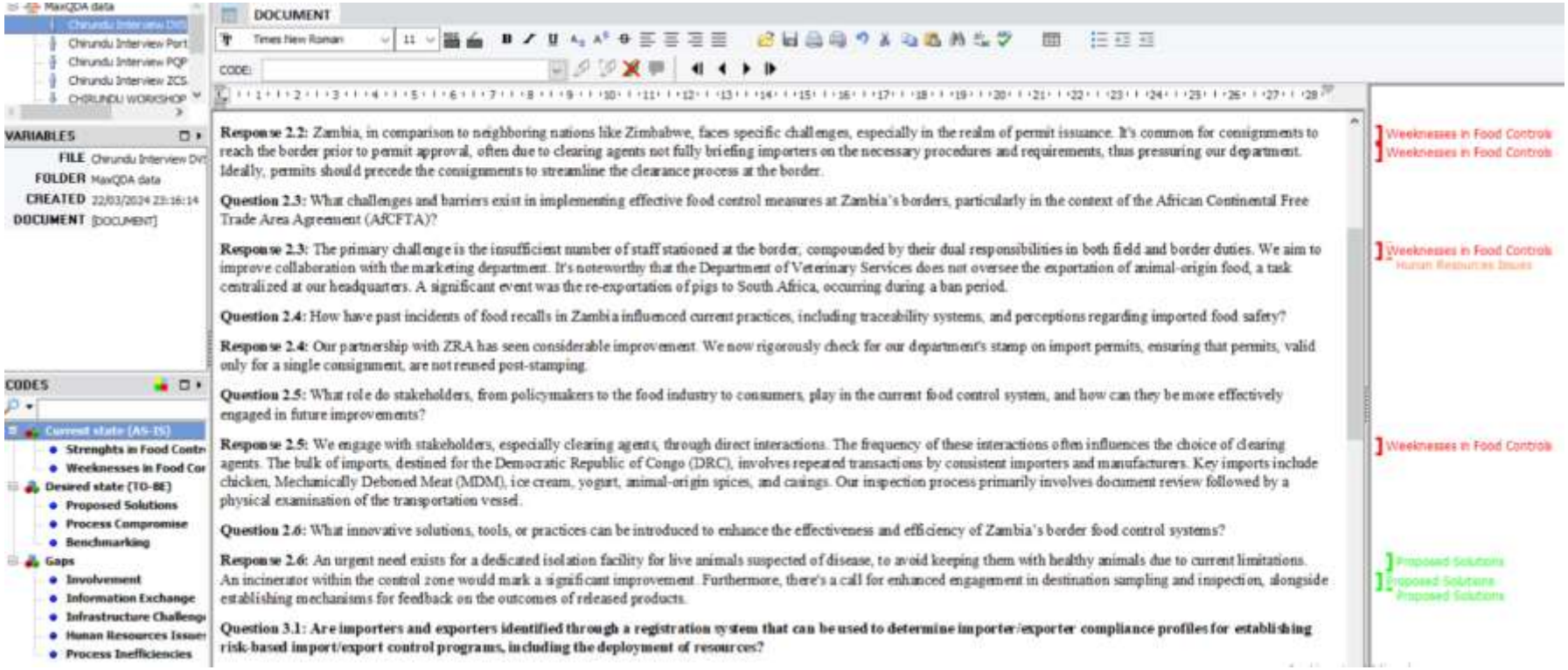

Figure 3.6: Identification of similarities between codes to assign or align them to the themes for the research

3.18.3 Searching for the themes (Phase three)

The deductive approach was adopted using the codebook approach, as illustrated in the Figure 3.8 below, because we needed some form of criteria to identify whether or not a piece of information may be conducive to addressing the research objectives. Coding and analysis typically do not adhere strictly to a single method, and instead, they frequently involve a mix of both techniques (Braun and Clarke, 2019). Continuous comparison of data across different cases or within the same case was conducted as suggested by Braun and Clark (2006) to refine the coding scheme to form an overarching theme (Braun and Clarke, 2006). The main purpose of this phase was to find out the patterns and relationships between and across the entire data set (Chamberlain, 2015). Thematic analysis is a constant-comparative method that involves reading and rereading the transcripts in a systematic way (Cavendish, 2011) and the most important aspect in the thematic analysis is that the analysis process should be systematic so that the final product is of good quality. Findings from interviews, observations, documents, and other sources were compared to corroborate evidence and strengthen interpretations.

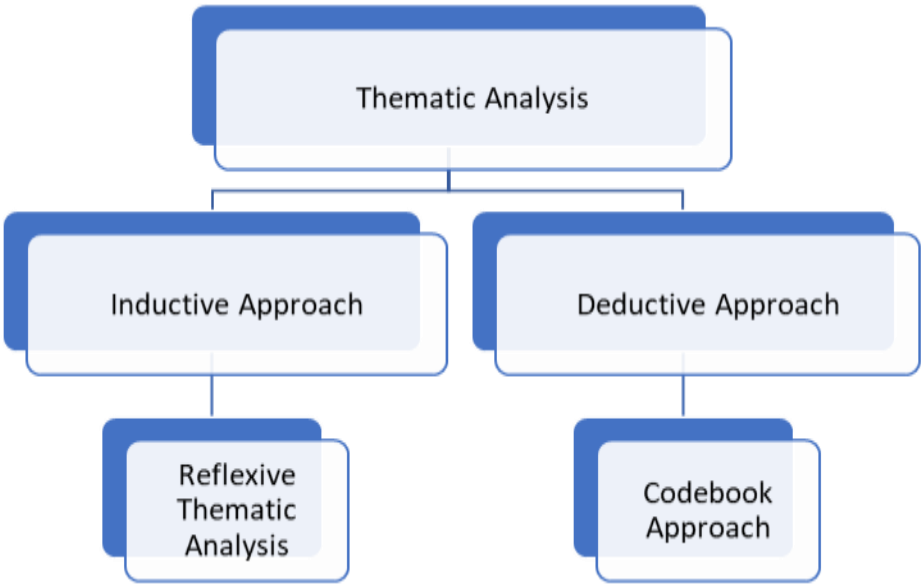

Figure 3.7: Schematic diagram of the two main approaches to thematic analysis

3.18.4 Review of the themes (Phase four)

During this phase, we reviewed the themes initially developed by checking if the themes work in relation to the coded extracts (the data) and the entire data set. In this step, we were able to

refine, split, combine, or discard themes. It's a crucial part of ensuring that the themes accurately reflect the data and effectively communicate the story the data tells. This was a two-step process that in which, initially, coded excerpts linked to preliminary themes were moved from QDA Miner to a Word document to ease cross-referencing and organization of codes and themes. Following this, a similar method was applied to the entire dataset in the second phase, to confirm that themes precisely reflected the data's overall meanings, ensuring the thematic map accurately captured the dataset's insights (Braun and Clarke, 2006).

3.18.5 Defining and Naming Themes (Phase five)

In this phase, after reviewing themes to ensure they accurately reflect the data set, we further refined the specifics of each theme by analysing each theme in detail, determining the essence of what each theme is about, and figuring out what aspect of the data each theme captures (Braun and Clarke, 2006). We then gave each theme a concise, punchy name that instantaneously gives a sense of what the theme is about. This phase is crucial for ensuring that the themes are not just identified but are also clearly defined and labelled in a way that communicates their meaning and relevance to the research question or objective. At this point, certain subordinate themes were combined with overarching themes upon recognizing that these more detailed themes would complicate the thematic map without significantly enhancing the narrative conveyed by the data.

3.18.6 Member Checking and Report Writing (Phase six)

Braun and Clarke (2006) emphasize that a thematic analysis report must persuade readers of its analytical rigor and validity (Braun and Clarke, 2006). Interpretations of the data were validated through member checking, involving feedback from participants or stakeholders involved in the case study. This ensured alignment between their perspectives and the analysis. Finally, the findings were presented in a clear, coherent manner in the research report, supported by sufficient evidence and examples drawn from the data. Quotations or excerpts were included to illustrate key points and enhance transparency in reporting.

3.2 Ethical considerations

Ethical clearance was obtained from ERES Converge IRB before the study was initiated. This step ensured that the proposed research adhered to established ethical guidelines, safeguarded participants' rights, and promoted the integrity of the research process. Alongside the

abovementioned clearance, registration was done with National Health Research Authority (NHRA) was also sought. NHRA's registration ensured the study aligned with national research standards, guidelines, and regulations.

Furthermore, participants were courteously engaged and consent was obtained prior to interviews, ensuring ethical conduct and respecting participants' autonomy (Appendix 1).

CHAPTER FOUR

RESULTS

4.1 Demographics of the border agencies involved in food control

A total of four border agencies were successfully engaged through key informant interviews, comprising personnel with professional experience in border food control ranging from 1 to 15 years. The selection of informants reflected a deliberate mix of authority levels and operational responsibilities, ensuring a balanced representation of perspectives and institutional realities. The onsite interviews further validated issues previously highlighted during workshop sessions, thereby enhancing the credibility and triangulation of the findings.

Regarding gender distribution, the participation of males consistently outweighed that of females across all data collection activities, as illustrated in Table 4.1. This trend may reflect broader structural gender dynamics within the border control and food safety enforcement sectors

Table 2.1: Distribution of research participants according to gender

Research activity	**Gender distribution**		**Total**
	Female	**Male**	
Chirundu workshop – April 2022	9	30	39
Chirundu workshop – May 2022	11	24	35
Nakonde workshop – April 2022	10	22	32
Nakonde workshop – May 2022	14	18	32
Chirundu Key Informant Interviews – February 2023	7	13	20
Total	**51**	**107**	**158**

The data shows that out of the total 158 participants engaged across both workshops and interviews, 107 (68%) were male while 51 (32%) were female. This gender disparity provides an important context for interpreting institutional practices and power dynamics in food control at border points

The four agencies were part of the six agencies that were allowed to operate at the borders under the coordinated border management. The six agencies include ZRA, Immigration Department, ZCSA, Port Health, NALEIC and PQPS. The Ministry of Commerce Trade and Industry was rolling out the Coordinated Border Management (CBM) system (Figure 4.1), with a key focus on enhancing trade facilitation through a strategic reduction of border agencies at physically operating at border posts (MCTI, 2024). Memoranda of Understanding (MOUs) were signed to facilitate delegation of functions to the six border agencies. During the workshops at the border posts, there were a total of seven and eight border agencies at Chirundu and Nakonde OSBPs, respectively.

Figure 4.1: Regulatory framework of the border food controls under the coordinated border management

4.3 Situation analysis

This study showed that there were prominent internal and external issues that directly affect the ability of the food control systems to achieve the legitimate objectives. The situational analysis

was conducted using a SWOT analysis, SWOT stands for strengths, weaknesses, opportunities and threats. The strengths and weaknesses were regarded as internal issues while opportunities and threats were regarded as external issues. The SWOT analysis was generated with input from the participants during then first workshop and then the questionnaire also provided an opportunity for key informants to supply information on strengths and opportunities.

Table 4.1: Internal and external issues determined by the border agencies

INTERNAL ISSUES	**STRENGTHS** **Regulatory Authority and Efficient Tracking:** Authority to implement disease control measures and efficient use of ASYCUDA for tracking commodities. Available and accessible international and domestic legal instruments. **Effective Partnerships and Engagement:** Strong partnerships between ministries and ZRA through the Coordinated Border Management; direct engagement with stakeholders enhances food safety and trade facilitation. Strong interagency and academia-government partnership **Capacity Building and Knowledge Enhancement:** Commitment to continual improvement through comprehensive learning and capacity building among border agencies.	**WEAKNESSES** **Resource and Infrastructure Gaps:** Challenges include lack of dedicated transport, insufficient staffing, poor connectivity to key systems like ASYCUDA and the Single Window, and inadequate infrastructure for effective risk management (lack of inspection bays, onsite laboratories). **Coordination and Information Sharing Challenges:** Inadequate coordination among agencies and lack of structured feedback mechanisms hamper enforcement consistency and process improvements.
EXTERNAL ISSUES	**OPPORTUNITIES** **Technological and Infrastructure Upgrades:** Potential for technological advancements and infrastructure improvements to enhance risk analysis, data collection, and overall food control measures. **Enhanced Collaboration and Communication:** Opportunities for better interagency coordination and improved stakeholder engagement, particularly in risk communication and public awareness. **Capacity Building for Inspection Efficiency:** Development of SOPs for risk-based inspections and continuous training presents opportunities to enhance inspection efficiency and food safety	**THREATS** **Challenges in Implementing SPS Measures:** Weak coordination among SPS agencies, inadequate financial resources, and insufficient scientific data for evidence-based decisions pose significant threats to effective SPS measure implementation. **Overlapping Roles and Inadequate Real-Time Data Exchange:** Overlaps among agencies and lack of effective electronic data exchange with neighboring countries and within the border ecosystem pose risks to security and health standards (misclassification of commodities) **Trade Facilitation and Compliance Risks**: Challenges in controlling porous borders, and inconsistencies in trade measures could hinder trade facilitation efforts and pose risks to compliance with food safety regulations especially in the wake of the AfCFTA.

4.4 Identification of traded commodities of economic significance

The study established that there are commodities of interlap within the regulatory overlap of the border agencies. This means that certain commodities fall under the jurisdiction of multiple border agencies due to overlapping regulatory responsibilities. The risk categorisation was different. This was the first step in identifying the need to develop SOPs that could be used for joint inspections. The risk categorization was based on current practice by agencies as outlined in Table 5.2. .

Table 4.2: Risk ranking of traded commodities undertaken by border agencies

	Border Agency	Commodities of Interest	High-risk commodities	Medium risk commodities	Low-risk commodities	Regulatory Overlap
1.	**Ministry of Agriculture (PQPS)**		• assorted seeds • assorted grains • potatoes • live plants	• assorted fruits and vegetables • timber • onion bulb • gum poles	• flower cuttings • sweet potato • maize meal • wooden packaging	• Hay • Maize bran • Fruits and vegetables
2.	**Ministry of Health (Port Health)**	• packaging material for foods • food additives • special dietary foods • alcoholic beverages in various forms • baking powdered • chocolate / cocoa products • coffee • food colours • spices • flavouring • fruits vegetables • Gelling agents • Cereal, grains • Legumes • Meat and its products • Game meat • Food additives • Salt sugar and vinegar • Tea • Marine and freshwater processed animals	• Meat and meat products • Milk and milk products • Margarine • Baby foods • egg and egg products		• Biscuits • Cremora • Cereals and cereal products • Tuber and tuber products • Spices • Juices • Food additives and preservatives	• Meat and meat products • Milk and its products • Fish and its products • Beef and chicken spices • Fruits vegetables and vegetable products
3.	**Zambia Compulsory Standards Agency**	• Food • Beverages • Rubber • Construction • Motor vehicle • Tanks	• Biscuits • Sugar • edible oils • peanut butter • Beverages			

4.4 As-Is Analysis

4.4.1 Legislative Framework and Authority

Strengths: The coordinated border management system is underpinned by strong legislative frameworks, such as the Animal Health Act No. 24 of 2010 and the Food Safety Act, No. 7 of 2019, Plant Pests and Disease Act CAP 233 and Compulsory Standards Act, No. 3 of 2017, granting essential authority to enforce food controls at the borders. Moreover, the delegation of specific functions through MOUs enhances the collaboration and effectiveness of various agencies involved in food control.

Weaknesses: Despite a well-defined legislative base, there are gaps in the implementation and operationalization of these laws, often due to overlaps in roles and responsibilities among agencies, leading to inefficiencies in enforcement.

The overlaps in roles and responsibilities among agencies in Zambia's coordinated border management system are significant and create substantial inefficiencies in enforcement. These overlaps result in the duplication of efforts, such as multiple inspections for the same standards, and conflicting decisions or actions between agencies, which cause confusion among stakeholders. Additionally, they lead to resource wastage, including time, personnel, and funds, due to redundant processes. Furthermore, delays in border clearance for goods undermine trade efficiency, negatively impacting both importers and exporters. These consequences highlight the operational challenges that arise from overlapping mandates.

The widespread nature of these overlaps is systemic, affecting multiple agencies involved in border food control. The issue is not isolated but pervasive across institutions tasked with enforcing key legislative frameworks, such as the Animal Health Act No. 24 of 2010 and the Food Safety Act, No. 7 of 2019, Plant Pests and Disease Act CAP 233 and Compulsory Standards Act, No. 3 of 2017. This suggests a structural problem in the coordination and delineation of responsibilities among various agencies, rather than an issue confined to a single institution or process.

Clients, particularly importers and exporters, face significant bottlenecks as a result of these overlaps. These include redundant inspections or paperwork from multiple agencies, prolonged processing times due to a lack of coordination, inconsistent enforcement, and unclear compliance

requirements. Such inefficiencies not only increase operational costs for clients but also create an unpredictable and cumbersome environment for trade. These bottlenecks hinder the smooth flow of goods across borders, ultimately affecting Zambia's trade competitiveness.

The root cause of these overlaps lies primarily in implementation challenges rather than deficiencies in the legislative framework itself. The laws, such as the Animal Health Act and the Food Safety Act, are well-defined and provide a strong foundation for enforcement. However, operational inefficiencies arise due to poor coordination among agencies in executing their roles, weak operationalization of Memoranda of Understanding (MOUs), and ambiguity in translating legislative mandates into clear and distinct workflows. These implementation gaps underscore the need for improved inter-agency collaboration and clearer operational guidelines.

4.4.2 Operational Efficiency and Coordination

Strengths: Integration into the ASYCUDA system and the strategic use of seals for destination inspections streamline operations. In order to promote stakeholder engagement and interagency collaboration there are regular meetings through the Coordinated Border Management Committee and direct communication channels like WhatsApp groups.

Weaknesses: The system suffers from insufficient coordination among border agencies and a lack of dedicated infrastructure such as transport and inspection bays, hampering the ability to conduct effective inspections. Furthermore, the absence of structured feedback mechanisms for post-destination inspections limits the opportunity for process improvement. Sometime there is no coordination from the counterparts in Zimbabwe with regard to the declared consignments. ASYCUDA System is actually beatable. So, we also rely of honest declarations of the HS codes by the importer in order to inspect the consignment.

4.4.3 Risk Assessment and Compliance

Strengths: PQPS's integration with ASYCUDA and ZCSA's risk-based inspection approach exemplify efforts to leverage technology for better compliance and risk management. The establishment of risk registers and reliance on MOUs for collaborative enforcement indicate a proactive stance towards managing food safety risks. Moreover, it was reported that ZRA through the ASYCUDA system had been running a risk management protocol that involved four

lane namely the green, blue yellow and red, arranged in order of risk ranking with green being the low risk to red which denoted high risk.

Weaknesses: A notable gap is the system's current inadequacy in conducting scientifically defensible risk assessments, leading to challenges in effectively identifying and managing food safety risks. This deficiency is compounded by the lack of direct involvement in laboratory operations and feedback on test reports, which are crucial for informed decision-making. A key informant interviewee said that "our current system does not formally conduct risk assessments that produce scientifically defensible risk estimates. Moreover, the lack of direct communication highlights a gap in our system's technical capabilities and coordination efforts, which is crucial for timely intervention and effective food control."

4.4.4 Resource Allocation and Infrastructure

Strengths: The commitment to training and capacity building, as evidenced by numerous workshops aimed at enhancing the efficiency and understanding of SPS and trade issues among border agency staff, highlights a strength in resource allocation towards human capital.

Weaknesses: Critical resource limitations, including inadequate staffing, unpredictable transport availability, and insufficient laboratory facilities, significantly hinder the system's ability to ensure comprehensive food safety controls. The delayed reporting of laboratory results further exacerbates these challenges. One of the respondents said "results from the laboratory take long to be reported sometimes even beyond four months".

4.5 To-Be Analysis

4.5.1 Infrastructure and Facilities Enhancements

Dedicated Isolation Facility: A proposed solution involves establishing an isolation facility for mandatory quarantine, diagnostic testing and monitoring of all imported or high-risk live animals, including asymptomatic individuals aimed at intercepting potential disease transmission through controlled quarantine measures.

Incinerator Installation: The installation of an incinerator within the control zone is suggested to manage waste and dispose of potentially contaminated materials safely, enhancing biosecurity measures at the border. One respondent said, "we would like to have a quarantine area. We also

would like to have our own incinerator here at the border. At the moment we are forced to use the one for Chirundu council".

4.5.2 Inspection and Sampling Enhancements

Enhanced Engagement: There is a proposal to increase engagement in destination sampling and inspections to ensure more rigorous scrutiny of consignments, thereby improving food safety outcomes.

Structured Joint Inspections: Advocating for more structured joint inspections among different border agencies to streamline processes, reduce redundancies, and enhance the thoroughness of inspections. Regulatory overlaps in mandates do not preclude joint inspections; rather, they underscore the need for structured collaboration to transform fragmented efforts into a unified system. By formalising roles, leveraging existing laws and adopting integrated processes, the coordinated border management system can convert overlaps from a source of inefficiency into a mechanism for comprehensive risk management.

Scanner Installation: Installing scanners at the passenger terminal is prioritized to facilitate the efficient screening of food items carried by domestic passengers, thus bolstering food safety measures.

4.5.3 Technological and Operational Improvements

Single Window System Connection: Improving operations by connecting to the Single Window system would facilitate the efficient processing of consignments and enhance inter-agency collaboration. A respondent mentioned that "Improving our operations could be achieved by connecting to the Single Window system, which would allow inspectors at different points to ensure confirmation of successful passage of consignments and enhance our efficiency, especially at the passenger terminal where installing a scanner has become a priority."

Pre-Inspection Interceptions: Enhancing efficiency by developing the capability to intercept consignments before they reach the Zambia Revenue Authority (ZRA), allowing for preemptive inspections based on risk assessments.

4.5.4 Process Compromises and Adjustments

Pragmatic Risk Categorisation: Adopting a more pragmatic approach to categorising risks based on general knowledge and historical data, acknowledging the challenges in conducting detailed quantitative analysis. This form of categorisation prioritises practicality, efficiency and realism over theoretical perfection or exhaustive analysis. It focuses on creating "good enough" categorisations that enable timely decision-making, even with imperfect data, by prioritising actionable insights aligned with available resources.

Sampling Strategy Adjustments: Adjusting sampling strategies to mitigate issues associated with delayed transportation and sample processing, thereby maintaining the integrity of food safety inspections despite logistical constraints.

4.5.5 Benchmarking and Best Practices

Learning from Regional Counterparts: Benchmarking against Zimbabwe's comprehensive approach to import and export inspections, which cover both passenger and commercial terminals, offering insights into effective border control practices.

Adoption of Government Service Bus (GSB): Looking at the integration into a government service bus (GSB) as seen in other countries, which could significantly reduce instances of forgery and improve data integrity.

4.5.6 Stakeholder Engagement and Awareness

Collaborative Sensitization Exercises: Organizing collaborative sensitization exercises about the role of national enquiry points to ensure producers and stakeholders have access to comprehensive and accurate information.

Awareness and Orientation Seminars: Proposing the organization of awareness and orientation seminars to educate stakeholders on food safety regulations, procedures and best practices, thereby enhancing compliance.

4.5.7 Laboratory and Analytical Capabilities

Laboratory Infrastructure Investment: Recognizing the need for significant investment in both the hard and soft infrastructure of laboratories to enhance their analytical capabilities and ensure the reliability of food safety testing.

Investments in Accreditation and Proficiency Testing: There was a proposal to invest in the accreditation of laboratories to provide valid and reliable results for sound regulatory decisions. One of the key informant interviewees reported that "there is a pressing need for significant investment in both the hard and soft infrastructure of laboratories to enhance their analytical capabilities. This includes increasing the number of accredited methods and parameters to give us more confidence about laboratory competence."

4.6 Gap Analysis

4.6.1 Human Resources and Capacity

Staffing Shortages and Dual Responsibilities: A recurring theme in the analysis is the acute shortage of personnel dedicated to food safety control at border points. The limited human resource capacity is further strained by the assignment of dual responsibilities, where officers are required to manage both field-based activities and border inspection duties. This overstretch significantly undermines the consistency and thoroughness of food control operations.

One of the key informants highlighted this challenge, stating: “The primary challenge is the insufficient number of staff stationed at the border, compounded by their dual responsibilities in both field and border duties. This severely limits our capacity to effectively manage and control food safety at the border.” The dual-tasking of personnel often leads to delayed inspections, inadequate follow-ups, and reduced oversight, especially during peak operational hours or emergency situations.

The current staffing model compromises not only the efficiency of food inspection protocols but also the credibility of the overall food control system. It points to the urgent need for targeted human resource investments and workload restructuring to ensure that food safety officers are optimally deployed and supported.

Limited Authority and Involvement in Sampling and Inspection: Another notable concern is the limited authority granted to some border agencies in the execution of food safety inspections and sample collection. In several cases, staff lack the necessary mandate or capacity to carry out these functions independently, resulting in delays, fragmentation of responsibilities, and inter-agency coordination challenges.

This structural limitation weakens the enforcement of food safety protocols and creates bottlenecks that may allow unsafe food products to enter the domestic market. It also limits accountability and slows down response times when food safety risks are identified. These findings underscore the importance of clearly defined roles, expanded mandates, and adequate resourcing for border agencies to function effectively within an integrated food control system

4.6.2 Information Exchange and Coordination

Inadequate Information Exchange and Coordination Among Agencies: A recurrent theme is the lack of structured, consistent information exchange and coordination among stakeholders, contributing to gaps in the system's technical capabilities. This is exacerbated by a reliance on informal communication channels and a general lack of integration with key systems like ASYCUDA, hindering timely interventions. Food control at borders isn’t the sole purview of one agency. It involves customs, health departments, agricultural agencies, trade agencies, and sometimes even local authorities. The lack of streamlined communication and coordination among these entities can result in redundancies, delays, and, at times, oversights in food safety protocols (UNCTAD, 2025). Article 8 of the WTO Trade Facilitation Agreement emphasizes the importance of cooperation between border regulatory agencies to facilitate trade and improve efficiency (UNCTAD, 2025). Effective coordination can reduce costs, speed up processing, and enhance customer satisfaction for traders (Cross-border Research Association, 2016).

Lack of Direct Feedback and Education: There is an absence of direct feedback mechanisms on the outcomes of inland inspections and a pressing need to educate and sensitize importers about regulations and standards. One of the responded stressed that "there is a critical need to enhance stakeholder engagement activities and sensitize importers about regulations to ensure compliance. Additionally, the lack of cargo scanners and dedicated laboratory spaces at border posts like Chirundu impedes our ability to conduct rapid and efficient testing."

4.6.3 Infrastructure and Technology

Critical Infrastructure Deficiencies: The findings reveal significant infrastructural constraints that directly undermine the effectiveness of food safety controls at border points. Key deficiencies include the absence of dedicated vehicles for transporting food samples, the lack of cargo scanners at passenger terminals, and inconsistent internet connectivity. These limitations severely impede the operational efficiency and responsiveness of inspection teams.

A recurrent concern raised by participants was the poor internet infrastructure, which affects the timely processing and communication of inspection data. One participant noted, “The internet speed at the border agencies during normal working hours is around 10 MBPS, which is way lower than what other agencies experience, which is around 50 MBPS. I normally use my personal router to get work going.” This highlights a dependence on personal resources to bridge systemic gaps, which raises issues of sustainability, equity, and operational integrity.

Insufficient Laboratory and Rapid Testing Facilities**:** Another emergent theme pertains to the absence of essential laboratory infrastructure and rapid testing facilities. The lack of designated space and equipment for conducting timely, on-site tests compromises the ability to detect and address food safety hazards in real time. This was echoed by a key informant who remarked, “We currently operate without a designated room to conduct rapid testing, a critical component of our inspection process. Additionally, the absence of dedicated vehicles for transporting samples further complicates our ability to ensure the safety of food entering the country through domestic channels.”

The convergence of these infrastructure-related gaps — from transportation to diagnostics and digital connectivity — exposes a critical vulnerability in the food control system. It underscores the urgent need for strategic investments to strengthen institutional capacity and support effective risk-based inspections aligned with international best practices

The model given in Figure 4.2 below shows the interdependencies of the infrastructure challenges highlighted by the border agencies.

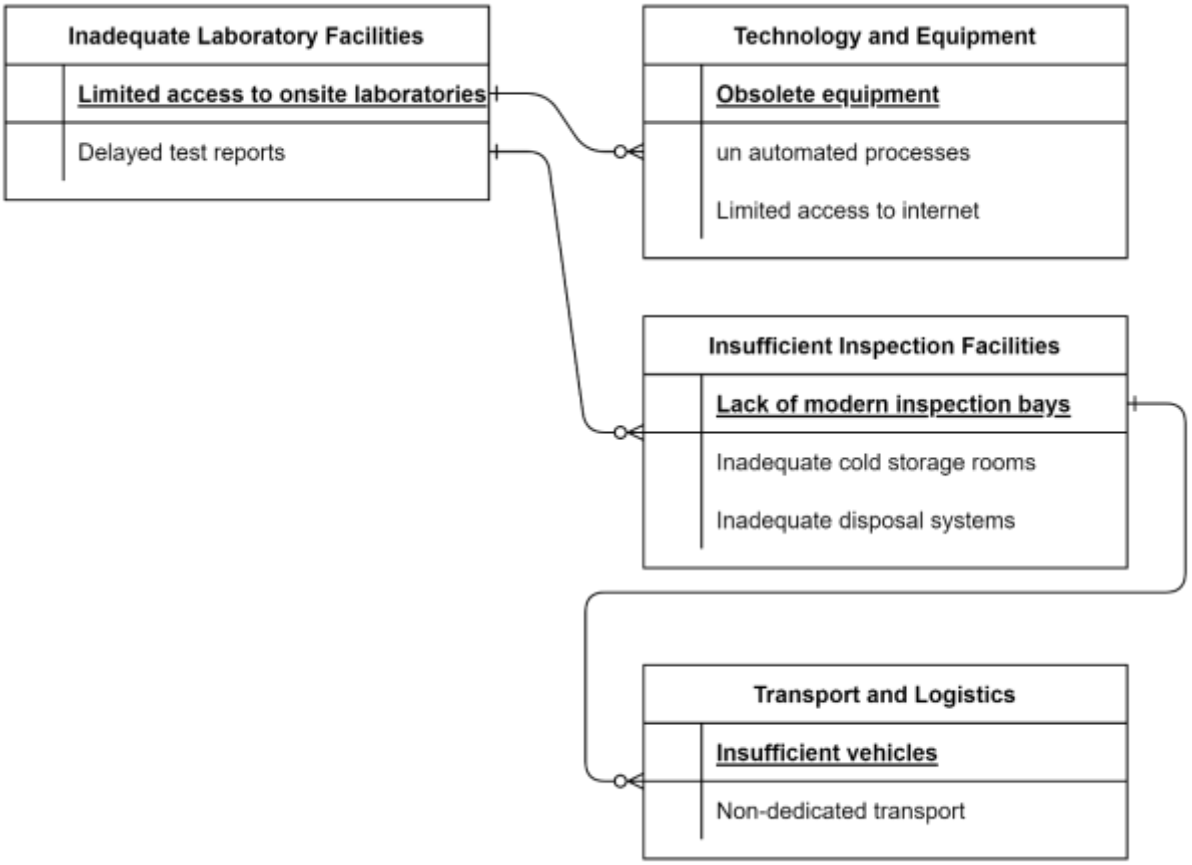

Figure 4.2: Conceptual model of the infrastructure challenges

4.6.4 Process Inefficiencies and Policy Gaps

Process Inefficiencies and Lack of Risk Profiling: Thematic analysis of the findings reveals significant process-related inefficiencies that hinder the implementation of a robust food safety risk management system. A key gap identified is the absence of structured risk profiling mechanisms. Current practices do not adequately categorize or prioritize food safety hazards based on risk, which weakens the ability of border agencies to apply targeted and risk-based interventions.

Moreover, the lack of digitalization and automation in back-office operations hampers the efficiency of food control systems. Limited infrastructure and technological capacity continue to constrain efforts to streamline documentation, traceability, and real-time risk analysis. These

systemic challenges result in reactive rather than proactive food safety measures, undermining the ability to detect and prevent hazards before they escalate into public health threats.

Policy Limitations and Oversight Gaps: Participants also pointed to restrictive policies and oversight gaps that diminish the effectiveness of food control operations at the borders. Notably, policies that prohibit border staff from escorting in-transit food commodities to their destination inspection points limit continuity in the inspection process and weaken accountability mechanisms.

One participant explained: “We don’t get to escort samples that are allowed to proceed for destination sampling and inspections, and yet we never get the results of the sampling and inspection activities from the in-land team.” This disjointed handover between border and inland inspection units reflects a breakdown in information flow and inter-agency coordination. The lack of feedback loops not only diminishes the confidence of border officials in the integrity of downstream processes but also impedes learning and improvement.

Additionally, the minimal involvement of border inspection staff in stakeholder engagement and policy discussions leaves them disconnected from decision-making processes that directly affect their operations. This lack of inclusion creates a policy-practice gap that frustrates implementation and dilutes frontline ownership of food safety mandates

4.6.5 Interconnected Weaknesses in Border Food Control

To effectively interpret the findings from the gap analysis, a conceptual framework has been developed to illustrate the systemic and cyclical nature of weaknesses affecting food control systems at border points. The framework (Figure 4.3) synthesizes the thematic categories that emerged from the study into four interrelated domains: **Human Resources & Capacity**, **Information Exchange & Coordination**, **Infrastructure & Technology**, and **Process & Policy Gaps**. These domains are not isolated; rather, they function in a loop, with weaknesses in one area amplifying vulnerabilities in the others.

The cyclic nature of the framework emphasizes that addressing only one component in isolation may yield limited results. For instance, increasing staffing levels (human resource input) may have minimal effect if communication channels across agencies remain fragmented or if policies restrict follow-through on inspection processes. Similarly, investing in laboratory equipment will not translate to improved outcomes if the staff lack the authority to act on the results or if inspection protocols are poorly digitized and tracked.

Each quadrant in the cycle reflects critical issues drawn directly from empirical findings. These include:

- **Inadequate staffing and unclear mandates** that weaken enforcement.
- **Poor inter-agency coordination** and lack of feedback loops that delay risk response.
- **Weak physical and digital infrastructure** that slows inspections and data transmission.
- **Fragmented procedures and restrictive policies** that prevent coherent risk-based food safety management.

Figure 4.3 below visualizes this cyclical interdependence, offering a systems-level view of how weaknesses reinforce each other and where holistic, cross-cutting interventions are required. The model provides a foundation for identifying strategic entry points for reform and capacity building in border food control operations

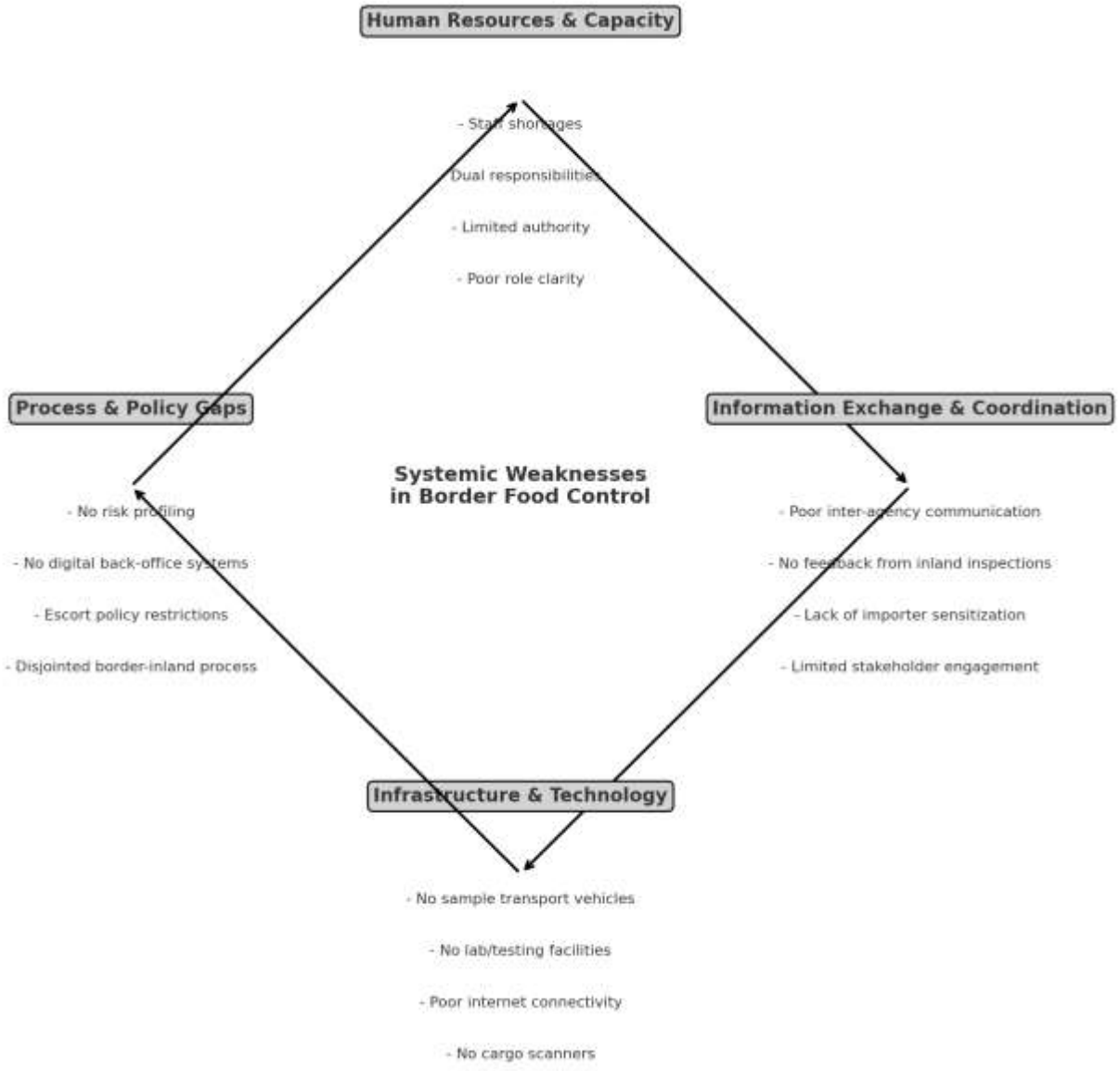

Figure 4.33 Systemic Weaknesses in Border Food Control. Designed by author using thematic analysis.

CHAPTER FIVE
DISCUSSION

This study evaluated Zambia's border food control systems at the Nakonde and Chirundu one-stop border posts with the primary objective of identifying actionable strategies to enhance food safety within evolving global and regional trade frameworks. The study addressed its objectives by examining current food control practices, benchmarking these against international and regional standards, and pinpointing operational, infrastructural, and institutional challenges. The analysis culminated in the design of a recommended border food control framework that integrates expert insights with established risk management principles to improve inspection processes at these vital entry points.

5.1 Current Strengths and Opportunities

Zambia's border food control systems are underpinned by an extensive legislative framework, notably the Food Safety Act No. 7 of 2019, which provides the regulatory basis for enforcing sanitary and phytosanitary (SPS) measures (Government of Zambia, 2019). Accordingly, the Zambia Revenue Authority (ZRA) has implemented a risk management system via ASYCUDA, assigning consignments to red, yellow, blue, or green channels based on criteria such as declared origin, commodity type, historical compliance data, and trade risk indicators (World Bank, 2018). Such operational advancements, alongside the Coordinated Border Management (CBM) system, facilitated through formal interagency partnerships and Memoranda of Understanding (MOUs), demonstrate significant progress in digitizing documentation and streamlining border processes (Cheruiyot & Rotich, 2018). Moreover, targeted capacity-building initiatives in risk-based inspections and the formulation of Standard Operating Procedures (SOPs) reflect a proactive commitment to adopting global best practices (ASEAN, 2022).

These findings are consistent with studies in other developing contexts, where legislative frameworks provide the foundation, but practical implementations vary widely (Pham & Dinh, 2020). Literature further emphasizes that Zambia's food control systems are significantly enhanced by such a comprehensive legislative framework (Kasongo, 2018). The Food Safety Act No. 7 of 2019 not only establishes a robust regulatory basis for SPS measures but also aligns Zambia's practices with international standards (FAO, 2017). The ZRA's use of the ASYCUDA system to classify consignments is shown to enhance border processing efficiency and reduce the

likelihood of pest introduction (Msiska et al., 2013). Additionally, capacity-building initiatives, coupled with interagency partnerships and MOUs, have been noted as important in facilitating streamlined operations and improved compliance (Whattam et al., 2014; Kanyinji et al., 2020). Modern technologies such as blockchain for traceability and mobile applications for education offer innovative solutions to enhance transparency, accountability, and consumer awareness, thereby advancing the overall safety and quality of the food supply chain (Patel et al., 2023).

5.2 Persistent Weaknesses and Gaps

Despite the above-noted strengths, the study revealed several important weaknesses. Implementation gaps in risk assessment protocols persist due to chronic understaffing and inadequate infrastructure. The research findings are consistent with other published finding. Many border posts lack the necessary facilities, such as modern inspection bays, cold storage for perishable goods, or even basic amenities for personnel, hindering effective food inspections (GAO, 2019). The Department of Homeland Security's U.S. Customs and Border Protection (CBP) has reported infrastructure constraints at land border crossings, including limited inspection capacity and technology challenges (GAO, 2019). Coupled with this is the constraint of limited human resources. Often, insufficiently trained personnel are on the ground, leading to potential oversights and inefficiencies (Homeland Security, 2025).

Laboratories, pivotal for verifying compliance, often face delays, undermining timely surveillance of foodborne diseases (FAO, 2017). Recent studies similarly report that chronic understaffing and limited training opportunities severely compromise the operational capacity of public health laboratories, resulting in delayed risk assessments and reduced efficacy in detecting foodborne hazards (Ngegba et al., 2025; Muyembe et al., 2024). This is a significant barrier to effective food safety management, as highlighted in other studies that advocate for the establishment of well-equipped laboratories at border points (Food Standards Agency, 2023).

Furthermore, the porous nature of borders, particularly at Nakonde, combined with fragmented monitoring systems, hampers effective traceability and elevates the risk of substandard or contaminated food entering domestic markets (Muyembe et al., 2024). Research corroborates these findings, highlighting that porous borders, when coupled with inadequate monitoring,

significantly increase the challenges in enforcing food safety regulations (Deepak et al., 2025). The lack of enforceable traceability regulations and integrated data-sharing mechanisms further exacerbates these challenges (ASEAN, 2022). Zambia has not fully embraced modern technology in its food control system. In a related study, it was demonstrated that Nepal has been unable to respond and adapt to new technology and changing consumer needs, leading to challenges in the regulation of food safety (Deepak et al., 2025).

The findings reveal significant infrastructural constraints that undermine the effectiveness of food safety controls at border points. Key deficiencies include the absence of dedicated vehicles for transporting food samples, the lack of cargo scanners at passenger terminals, and inconsistent internet connectivity. These limitations severely impede the operational efficiency and responsiveness of inspection teams. This is consistent with global best practices that advocate for advanced scanning technologies to enhance border security and food safety (WHO, 2023).

The need for enhanced internet connectivity cannot be over emphasized. This issue is not unique to your study; other research also points to the critical role of reliable internet connectivity in modernizing border inspection systems and improving operational efficiency (Food Standards Agency, 2023). Furthermore these findings align with global standards that emphasize the importance of infrastructure and technology in food safety controls. The World Health Organization (WHO) and other international bodies advocate for science-based food safety measures, simplified procedures, and electronic certification to enhance food safety and trade facilitation (WHO, 2023). Other studies highlight the need for significant investment in technology, including cargo scanners, dedicated vehicles, and rapid testing facilities, to improve food safety controls at border points (Food Standards Agency, 2023). Capacity building and assistance programs are crucial for improving regulatory and administrative capacity at border points, including training for staff, upgrading infrastructure, and implementing modern technologies (WHO, 2023)

These systemic issues align with findings from similar studies in developing economies, where resource constraints and institutional fragmentation frequently impede the effective implementation of food safety measures (Adewoye et al., 2024; Peh et al., 2024). Despite these challenges, some studies indicate that targeted interventions, such as enhanced training programs

and increased resource allocation, can improve laboratory capacity and overall food safety systems (Adewoye et al., 2024; Peh et al., 2024). This evidence suggests that while Zambia's border food control systems face significant hurdles, strategic investments and targeted reforms have the potential to mitigate these weaknesses and enhance system-wide effectiveness.

5.3 Implications for Food Safety and Trade

The implications of these findings are substantial. Inefficient border inspections not only increase the risk of unsafe food reaching consumers but also jeopardize Zambia's compliance with international trade agreements, potentially undermining the country's reputation in global markets (ASEAN, 2022). The study highlights the need for strategic investments in modernizing laboratory infrastructure, upgrading facilities, and incorporating rapid detection tools for the timely identification of food safety hazards (Abia et al., 2024). Deploying real-time communication and automated risk assessment tools can streamline border inspections and improve decision-making processes (Trouvé & Robinson, 2024; Porouhan, 2023). Enhancing interagency coordination under a "One Health" framework is also essential, promoting collaboration among various sectors to ensure a comprehensive approach to food safety and public health (Eruaga, 2024).

Notably, regional models, such as Zimbabwe's integration of border services into a Government Service Bus (GSB) to reduce fraud and streamline operations (World Bank, 2018), offer tangible examples of how operational adjustments and technological integration can lead to improved food safety outcomes even in resource-constrained settings (ASEAN, 2022). Leveraging innovations like blockchain and IoT further enhances traceability and accountability in the food supply chain, thereby reducing the risk of agri-food fraud and contamination (Eruaga, 2024). These comparisons underscore the transformative potential of adopting advanced technologies and integrated systems, which can harmonize food safety regulations, optimize resource allocation, and ultimately strengthen border control efficacy to protect public health and bolster global trade performance (Tibebu et al., 2024).

5.4 Effectiveness of One-Stop Border Posts

The effectiveness of one-stop border posts (OSBPs) in Zambia, such as those at Nakonde and Chirundu, has been a subject of considerable interest. Studies indicate that OSBPs have

significantly improved the efficiency of border operations by reducing clearance times and streamlining processes (Cheruiyot & Rotich, 2018). For instance, the implementation of OSBPs has led to faster processing of goods and reduced waiting times for traders, which in turn lowers the cost of doing business and enhances trade facilitation (Mutua & Kilonzi, 2023). This efficiency is achieved through coordinated efforts among various border agencies, integrated information technology systems, and the adoption of risk management techniques (IOM, 2025).

However, the effectiveness of OSBPs is not uniform across all borders. Borders that are not under the OSBP framework, such as those with porous characteristics, face significant challenges in maintaining food safety standards. Porous borders allow for the unregulated movement of goods, which can lead to the entry of substandard or contaminated food products into the market (Ladan & Matawalli, 2020). This undermines the efforts of SPS agencies to enforce food safety regulations and compromises the overall integrity of the food supply chain (Howell et al., 2018).

The presence of porous borders exacerbates the difficulties in achieving food safety objectives, as it hampers effective monitoring and traceability of food products. This situation is further complicated by inadequate inspection infrastructure and testing facilities, which are critical for verifying compliance with food safety standards (FAO, 2017). Studies have shown that porous borders in regions like Nigeria and Ghana contribute to the proliferation of substandard goods and pose significant challenges to national integration and security (Obah-Akpowoghaha et al., 2020; Brunei-Jailly & Dupeyron, 2020). Therefore, while OSBPs have shown promise in enhancing border efficiency and food safety, there is a need for comprehensive strategies to address the challenges posed by porous borders and inadequate infrastructure to ensure the realization of food safety objectives at all border posts.

CHAPTER SIX
CONCLUSION, RECOMMENDATIONS AND LIMITATIONS,

6.1 Conclusion

In conclusion, this study provides an in-depth analysis of Zambia's border food control systems at the Nakonde and Chirundu one-stop border posts, shedding light on the strengths, weaknesses, opportunities, and gaps within the current framework. The research, conducted through workshops and key informant interviews, particularly at the Chirundu border post, underscores the critical role of human resources, information exchange, and infrastructure in shaping the effectiveness of food control systems. The findings reveal significant strengths, including established legislative frameworks, the strategic use of technology, and collaborative efforts among border agencies. However, challenges such as insufficient staffing, limited involvement in key processes, and infrastructure inadequacies highlight areas needing attention to bolster the food safety regime.

The proposed model to enhance Zambia's border food control systems aims to address these challenges by recommending a risk-based model as well as comprehensive approach effectively managing food safety at ports of entries that includes bolstering human resources, improving information exchange mechanisms, enhancing infrastructure, and fostering greater collaboration among all stakeholders. By addressing the identified gaps, Zambia can better safeguard public health, ensure compliance with international food safety standards, and facilitate trade more effectively.

This study's limitations, primarily its focus on Chirundu through key informant interviews and the exclusion of a broader stakeholder group, suggest areas for future research. Longitudinal studies and expanded engagement across more border posts and diverse stakeholders could provide a more comprehensive understanding of the dynamics at play and further refine the strategies for improving Zambia's border food control systems.

In the context of evolving global and regional trade dynamics, this research contributes valuable insights toward strengthening food safety measures at Zambia's borders. By

adopting the recommended enhancements, Zambia can not only protect its citizens but also position itself as a leader in regional food safety, ultimately supporting economic growth and public health objectives.

6.2 Recommendations

a) It is recommended that the Government ensured that a risk-based inspections framework is implemented at the border post and ensure that all the border agencies responsible for food controls are connected. The world following risk-based model, adapted from the World Bank is being proposed:

$$IMPORT\ RISK = PRODUCT\ RISK\ (A) + COUNTRY\ RISK\ (B) + FACILITY\ RISK\ (C) + IMPORTER\ RISK(D)$$

b) There is a need for government to take decisive action on the improvement of information exchange and coordination: Establishing formal channels for consistent and structured information exchange among all stakeholders, including the full integration with the Automated System for Customs Data (ASYCUDA). Additionally, conversations about a Rapid Alert System for the notification of food safety incidences in Zambia, should also begin to take shape, with SMART Zambia recommended to take ownership and leadership of these discussions in order to come up with local solutions that are in tandem with global practice.

c) There is a need for the government to actively implement the streamlining processes and updating policies including the Food Safety Policy which has been in draft form for a long time. Implementing a more structured approach to risk profiling and categorization. Updating policies to enhance involvement in joint sampling, inspection, and stakeholder engagement activities. The discussions about a Food Safety Authority should be revived and reviewed as possible sustainable solution to the glaring gaps. There is an opportunity for government to revise the Bill of Rights in the Republican Constitution in order to ensure that the right to safe food well documented.

d) There is a need for government to increase resource allocation towards food safety. It is recommended that the government should upgrade food safety

related hard and soft infrastructure in order to improve the turnaround times of the testing, inspections and certification processes. There is an opportunity for the government to deliberately make food safety (access to safe food) become a programme/subprogramme in the Yellow Book.

e) There is a need for the government to facilitate financial and technical support towards the accreditation of testing laboratories such as the national food laboratory, extension of accreditation scope for laboratories such as the Zambia Bureau of Standards and the Central Veterinary Research Institute. Additionally, due consideration should be given to the accreditation of inspection services offered by Port Health, PQPS and NALEIC while at the same time extending the scope of accredited inspection services offered by the for Zambia Compulsory Standards Agency.

f) Government should consider implementing Pre-shipment Verification of Conformity (PVoC) and Supplier Declaration of Conformity (SDoC) as appropriate as to help reduce the likelihood of substandard food products entering the Zambian Markets. The advantage of PVoC or SDoC over Destination Sampling is it allows the regulator to outsource the compliance checks associated with imported products thereby dealing with the food safety hazards at source, especially where there is a limited capacity to perform these checks within the destination country.

g) A more comprehensive research that will expand the time or geographical coverage should be conducted to inform policy makers on the effectiveness of the current food control system in the country.

6.3 Limitations

a) Limited scope of the research. This research was iterative approach that mainly focused on the legislative, regulatory and administrative aspects but might overlook other critical dimensions of food control systems, such as technological infrastructure or the socio-economic context influencing smuggling and non-compliance.

b) Workshop dynamics affect the performance of the facilitator and participants who are regarded as research apparatus. Dominant personalities can skew discussions, and some participants may withhold their views in group settings.
c) Temporal limitations. The information gathered represents a snapshot in time. Border control policies, procedures, and challenges may evolve, and what is accurate at the time of research could change, affecting the relevance and applicability of our findings over time.
d) Variability in expertise. The level of expertise and experience among key informants can vary significantly, which might affect the quality and depth of insights into specific areas of the food control system.
e) Generalizability of findings: Conducting key informant interviews solely at Chirundu border post may limit the generalizability of your findings to other border posts across Zambia or similar contexts in other countries. Different border posts might have unique challenges and strengths not captured by focusing on a single location.

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APPENDICES

APPENDIX 1: LETTER OF INTRODUCTION AND INFORMED CONSENT FORM

INFORMED CONSENT FORM

Request: My name is Mwangelwa Charles Matongo, a student at the University of Zambia. I am requesting your participation in the study.

What is the title of the project? A food systems approach to design a risk-based food control border framework for Zambia. A Nakonde and Chirundu One-Stop Border Posts Case Study.

Brief description of the study

As a net food importer with limited exports, Zambia relies heavily on the safety and quality of imported foods. However, being resource-poor with an estimated poverty incidence of 60% poses an inherent challenge: balancing efficient trade processes with effective safety controls. Inefficient border controls can inadvertently allow the influx of unsafe or low-quality foods, jeopardising public health and shaking consumer confidence in the food supply chain. This leads to pertinent questions: Given Zambia's unique challenges of food insecurity and resource constraints, how effective and efficient are its border food controls?

This research aims to bridge the current knowledge gap by evaluating the effectiveness of Zambia's existing food control system. Doing so will pave the way to envision an improved future scenario, develop necessary indicators, and assess progress towards achieving optimal food safety measures at the borders. Such an evaluation will identify gaps in the current system and provide invaluable data to guide resource allocation.

Ultimately, the goal is to ensure that the Zambian population consumes imported food that is both safe and of acceptable quality.

Who is running the study? The study is conducted by a master's student from the University of Zambia pursuing Food Safety and Risk Analysis.

Do I have to participate? Your participation in this study is entirely voluntary, and you are under no obligation to take part. Your decision to participate or decline will not result in any adverse consequences. Should you choose to enrol, you are free to skip/omit responses to any questions you might find to be personal or uncomfortable without facing any penalty. Furthermore, you retain the right to withdraw from the study at any point without incurring any penalties. Your voluntary involvement as a subject matter expert is highly valued, and your privacy and autonomy will be rigorously respected throughout the course of the study.

What will happen to me if I participate in the study? Should you choose to participate in the study, you will be invited to provide insights into your daily activities related to border food inspection. This will involve a series of inquiries exploring your current work practices, potential challenges encountered, and your valuable recommendations for enhancing and refining these

practices. Your input will play a pivotal role in contributing to a comprehensive understanding of the food control systems at the borders, ultimately aiding in the improvement of the governance of food safety. Your perspectives are highly valued, and the information you share will be treated with the utmost confidentiality and respect.

Are there any risks if I participate in the study? Participating in the study requires your time commitment to answer questions comprehensively. We value your time, and your contributions are crucial for the research's success. We assure you that questions will be clear and relevant, and efforts will be made to minimise any disruption during your participation.

Are there any benefits from the study? Participation in the study involves providing insights into border food inspection activities, current work practices, challenges, and recommendations. While there are no direct personal benefits, your input contributes to a better understanding of the existing state of food control systems (As-Is Scenario). The study's findings will inform interventions for an improved future state (To-Be Scenario) of the food control system.

Will there be any compensation for being in the study? While we deeply appreciate your willingness to participate, it's important to note that, regrettably, there is no provision for compensation to volunteers for their valuable contributions to this study.

How long does the study last? This study entails the completion of a set of open-ended questions through interactive discussions, which are expected to take up to three days of half-day workshops. There is no subsequent follow-up or additional information required. However, should the necessity for further clarification arise, a virtual session may be arranged at your convenience to ensure thorough understanding and comprehensive responses.

Who will be able to see my information: Your information and institution details will be highly confidential and accessible only to those directly involved in the study. Your identity will remain anonymous, referenced solely by a study identification number in any resulting reports.

Who can I contact about the study or my rights as a volunteer in this research study? If, during the course of this study, you have questions concerning the nature of the research, you should contact:

Mwangelwa Charles Matongo

Master of Science student in Food Safety and Risk Analysis

Department of Disease Control

School of Veterinary Medicine

University of Zambia

Phone: +260 968 919 614

Email: mcmatongo@gmail.com

What if you have questions about your rights as a research participant: All research on human volunteers is reviewed by ERES Converge IRB, a committee that works to protect your rights and welfare. If you have questions or concerns about your rights as a research participant, you may contact:

The Chairperson

ERES Converge IRB

272 Meanwood Road, Meanwood Ibex

LUSAKA

Landline Telephone: 0211-230-581

Phone: +260 955 155633/ +260 955 155634

Email: eresconverge@yahoo.co.uk

IF THERE IS ANY PORTION OF THIS CONSENT AGREEMENT THAT YOU DO NOT UNDERSTAND, PLEASE TALK TO SOMEONE FROM THE STUDY TEAM BEFORE SIGNING.

INFORMED CONSENT FORM

Title of Study: A food systems approach to design a risk-based food control border framework for Zambia. A Nakonde and Chirundu One-Stop Border Posts Case Study.

Principal Investigator: Mwangelwa Charles Matongo

Participant's Agreement:

The above document describing the benefits, risks and procedures of this study has been read and explained to me. I have been told that joining this study is voluntary and that I can withdraw at any time or skip some questions without any consequences. I have been given an opportunity to ask any questions about the study, and all my questions have been answered. I voluntarily agree to participate in this research study as described.

_____
Name (print)

_____ _____
Signature or Thumbprint Date

I certify that the nature, purpose, potential benefits and possible risks associated with participation in this study have been explained to the individual participant.

_____ _____
Signature of Research Team Member Obtaining Consent Date

I was present throughout the entire informed consent process with the volunteer. All questions from the volunteer were answered, and the volunteer agreed to take part in the study.

_____ _____
Signature of Witness Date

_____
Printed Name of Witness

***Note 1: Witness name, signature and date are required on this consent form only when the consenting volunteer is not able to read (illiterate).**

***Note 2: For direct observations of food inspections at the Border Posts, Informed Consent will be obtained after the observations. This is in line with ethical norms for observational studies.**

APPENDIX 2: SUPPLIMENTARY QUESTIONS

A FOOD SYSTEMS APPROACH TO DESIGN A RISK-BASED FOOD CONTROL BORDER FRAMEWORK FOR ZAMBIA. A NAKONDE AND CHIRUNDU ONE-STOP BORDER POSTS CASE STUDY

1 PARTICIPANT GENERAL INFORMATION

1.1 Participant Identification: .....

1.2 Name of Institution: .....

1.3 Name of Border Post: .....

1.4 Participant's Work Experience: ..... (Years)

2 SUPPLIMENTARY QUESTIONS

2.1 What are the current strengths and weaknesses of the food control systems at Nakonde and Chirundu's One-Stop Border Posts?

2.2 How do Zambia's border food control practices compare with global and regional best practices?

2.3 What challenges and barriers exist in implementing effective food control measures at Zambia's borders, particularly in the context of the African Continental Free Trade Area Agreement (AfCFTA)?

2.4 How have past incidents of food recalls in Zambia influenced current practices, including traceability systems, and perceptions regarding imported food safety?

2.5 What role do stakeholders, from policymakers to the food industry to consumers, play in the current food control system, and how can they be more effectively engaged in future improvements?

2.6 What innovative solutions, tools, or practices can be introduced to enhance the effectiveness and efficiency of Zambia's border food control systems?

3 ADDITIONAL QUESTIONS RELATED TO RISK ANALYSIS

3.1 Are importers and exporters identified through a registration system that can be used to determine importer/exporter compliance profiles that can be used to establish risk-based import/export control programmes including the deployment of resources?

3.2 Are the sampling and inspection plans based on a well-documented risk categorization framework?

3.3 Is there sufficient infrastructure and technological capacity to conduct data collection to support risk analysis activities?

3.4 Are data from routine inspection, monitoring and surveillance programmes used to inform new or current risk analysis activities?

3.5 Are risk assessments being conducted and do they deliver scientifically defensible risk estimates (qualitative or semi-quantitative)?

3.6 Are there available food safety policy and strategy and is information on food control measures published and available to all stakeholders?

3.7 Is there a formal communication mechanism in place between stakeholders involved in food control, to exchange relevant information over the entire food chain, from primary production to human health?

3.8 Is food legislation unambiguous and does it allow for delegation of some functions to other public or private entities?

3.9 Does the national system of laboratories have sufficient technical capabilities to address priority hazards and quality parameters for food analysis, and the analysis of clinical samples for detection of FBDs?

APPENDIX 3: ETHICAL CLEARANCE FROM ERES CONVERGE IRB

Plot No. 272, Cnr Olive Tree Manorwood Road,
Manorwood Ext
Lusaka - Zambia
Tel: +260 955 155 633
+260 955 155 634
Cell: +260 977 493 220
Email: eresconverge@yahoo.co.uk

I.R.B. No. 00005948
F.W.A. No. 00011697

08th January, 2024.

Ref. No. 2023- Nov- 007

The Principal Investigator
Mr. Charles Matongo
Department of Disease Control
School of Veterinary Medicine
The University of Zambia
Lusaka, Zambia

Dear. Mr. Matongo

RE: A FOOD SYSTEMS APPROACH TO DESIGN A RISK-BASED FOOD CONTROL BORDER FRAMEWORK FOR ZAMBIA. A NAKONDE AND CHIRUNDU ONE-STOP BORDER POSTS CASE STUDY

Reference is made to your protocol submission. The IRB resolved to approve this study and your participation as Principal Investigator for a period of one year.

Review Type	**Ordinary**	Approval No. **2023-Nov-007**
Approval and Expiry Date	Approval Date: 08th January, 2024	Expiry Date: 07th January, 2025
Protocol Version and Date	Version - Nil.	07th January, 2025
Information Sheet, Consent Forms and Dates	• English.	07th January, 2025
Consent form ID and Date	Version - Nil	07th January, 2025
Recruitment Materials	Nil	07th January 2025
Other Study Documents	Questionnaires	07th January, 2025
Number of participants approved for study		07th January, 2025

Specific conditions will apply to this approval. As Principal Investigator it is your responsibility to ensure that the contents of this letter are adhered to. If these are not adhered

to, the approval may be suspended. Should the study be suspended, study sponsors and other regulatory authorities will be informed.

Conditions of Approval

- No participant may be involved in any study procedure prior to the study approval or after the expiration date.
- All unanticipated or Serious Adverse Events (SAEs) must be reported to the IRB within 5 days.
- All protocol modifications must be IRB approved prior to implementation unless they are intended to reduce risk (but must still be reported for approval). Modifications will include any change of investigator/s or site address.
- All protocol deviations must be reported to the IRB within 5 working days.
- All recruitment materials must be approved by the IRB prior to being used.
- Principal investigators are responsible for initiating Continuing Review proceedings. Documents must be received by the IRB at least 30 days before the expiry date. This is for the purpose of facilitating the review process. Any documents received less than 30 days before expiry will be labelled "late submissions" and will incur a penalty.
- Every 6 (six) months a progress report form supplied by ERES IRB must be filled in and submitted to us.
- A reprint of this letter shall be done at a fee.

Should you have any questions regarding anything indicated in this letter, please do not hesitate to get in touch with us at the above indicated address.

On behalf of ERES Converge IRB, we would like to wish you all the success as you carry out your study.

Yours faithfully,
ERES CONVERGE IRB

Dr. Jason Mwanza
Dip. Clin. Med. Sc., BA., M.Sc., PhD
CHAIRPERSON

APPENDIX 4: PROPOSED RISK BASED MODEL (ADAPTED)

Description of the risk factors involved in determining import risk of food commodities

Product Risk (A) Weightage = 40%	**Country Risk (B)** Weightage = 20%	**Facility Risk (C)** Weightage = 20%	**Importer Risk (D)** Weightage = 20%
High inherent risk: Contaminants possible. Measures product's post-market performance and safety incidents.	Mutual Recognition Agreements on harmonization and inspection equivalence. Efficient information exchange, including rapid alerts	Product, Process or Management System Certifications Schemes in place. Utilizes Pre-shipment Verification of Conformity (PVoC) for high-risk foods or Self Declaration of Conformity (SDoC) for medium-risk and low-risk foods.	Importer's incidents of noncompliance (rejections, detentions, and seizures) Four consecutive number incidents of compliance (Document review and/or product evaluation).