

Risk Cultures, Beef Traceability, and Food Safety in the United States and Zambia

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ABSTRACT

Understanding ways of improving the safety of food is an important area of research. In this project, I explore the history of the food safety systems in the United States and the Republic of Zambia. Focusing on the traceability of meat (as a form of risk management), I reveal the factors shaping each of these systems, with an eye towards their similarities and differences. I argue that food safety systems come to look different due to how these regulatory systems differently define risk, some of which traceability has brought to light. In both countries, what influences risk cultures is trust in institutions, political leaders and in science and technology. For the Zambian public, trust is in local political leaders, in individuals and in brands. For the US public, trust is in information and knowledge of producers, which is found on labels. While the Zambian public generally trusts institutions, the US public, due to its history of institutional failures, does not.

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GENERAL AUDIENCE ABSTRACT

Tracing where food comes from can be an important aspect of our food system. In this project, I show why food safety systems in the United States and Zambia look the way they that they do today. I do this by specifically focusing on how the two nations trace beef throughout the food supply chain. I show the different factors that have led to the food systems to look the way they do. My argument is that in the US and Zambia, there are non-scientific reasons why these food systems to look the way that they do today and why these countries address risk differently.

Dedication

For JMJ for their constant support in more ways than I can count.

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Chapter 1

Introduction

Contextualizing Traceability and Food Regulatory Systems

Food safety is one of the most important aspects of food and food regulatory systems (Rohr et al., 2005). Understanding ways of improving the safety of food is an important area of research. In this project, I explore how food safety systems come to be structured by looking at the history of two nations and their food regulatory systems: The United States and the Republic of Zambia. Specifically, I focus on factors influencing the formation of each food regulatory system and how each differs in their approach to food safety, especially through the use of meat traceability (as a form of risk management). I primarily focus on beef as it is a common food in both the US and Zambia.

Using a comparative analysis, I demonstrate differences and similarities in approaches to food safety in these two countries that have led to the formation of these regulatory systems. The main questions that this project answers are:

- a) How did each nation form its modern food safety regulatory system, and why does it take the shape that it does?
- b) How does each of the two countries define and approach risk when it comes to food safety?
- c) What is the role of traceability of meat (beef) in risk management and in turn food safety?

Using a comparative analysis to understanding food safety regulation from a Science and Technology Studies (STS) perspective provides useful insight into how colonization, the availability of technologies, culture, and diet inform the structure of food systems. This is not the first STS study of food safety regulation, but previous studies have primarily explored Western countries and how they apply food safety regulation, without considering the central issue of traceability. Building on past studies, this study includes a non-western country to explore possible similarities and differences between a Western country and one from a different cultural setting.

Definitions

In the United States, food safety is defined as “a reasonable certainty in the minds of competent scientists that the [food] substance is not harmful under the conditions of its intended use” (9 CFR 21, 2020). This definition entails a confidence in the expertise of scientists and the preventative measures used to arrive at conditions that are not harmful to consumers. The US has two main bodies regulating food safety, and these bodies further apply this definition in their approach to food safety. They are the Food and Drug Administration (FDA) (FDA, 2018) and the United States Department of Agriculture (USDA) (USDA, 2021) The FDA is responsible for regulating the majority of foods (and drugs) in the United States that are not meat, with the exception of seafood, while the USDA oversees mainly agricultural products and meat products, with the exception of seafood (USDA, 2021). Zambia, unlike the US, has several regulating authorities (FAO, 2018). These authorities use legislation by the Ministry of Health and the Ministry of Agriculture to govern food and health related issues. Zambia’s Ministry of Health is charged with overseeing all health-related issues including food borne illnesses and formulating laws on Food and Drugs and conduct research on public health concerns to protect the public.

The Ministry has specific departments that are responsible for specific health issues such as public health (Ministry of Health, 2019). The Ministry of Agriculture oversees Zambia's agriculture sector including foods such as meat and grain. The ministry is also charged with overseeing the safety of these agricultural foods through its departments (Ministry of Agriculture, 2019). In addition to these two ministries, food safety issues are also regulated by the Ministry of Local Government through its local authorities.

Food safety in both countries includes processes for ensuring safety such as developing and following Hazard Analysis Critical Control Points (HACCP) plans. These plans are written specific to each food product, process and facility and are followed by manufacturers to prevent contamination and or growth of foodborne pathogens. These plans consist of monitoring procedures, identification of hazards, and corrective actions that are intrinsic to processing facilities and are dependent on the type of food product being produced. Food safety regulatory bodies enforce other risk assessment and management strategies to combat food safety issues, depending on the type of food and the specific capacity of the countries in which they exist (FDA, 2021).

Food traceability names the methods used to track foods from their point of production to consumers' tables (Schwägele, 2005). Traceability methods may include placing stickers with bar codes, especially on fresh produce, or sensor technologies such as Radio Frequency Identification (RFID) technology. This technology involves a wireless system that uses tags and readers and is one of the most common methods of food traceability used. These systems communicate information to nearby readers about the identity of the product, whether passive or active (FDA, 2018). Such technologies allow producers, regulators, or consumers to trace their origins in case of an outbreak and to also inform the consumer on the origin of the food (USDA,

2021). Broadly, this also enables producers to remain accountable for maintaining high quality and safe foods because traceability functions as a transparency device in risk management and as a means to having an integrated, well-functioning food supply chain (Golan et al., 2004). In this manner, producers can ensure foods have a known point of origin and destination which is beneficial to their business and the food supply chain.

An area of concern in the food industry postproduction are food recalls. In the US, recalls are issued whenever a product violates federal laws or when a product could potentially cause harm to consumers (FDA, 2021). These recalls can either be voluntary or involuntary depending on the relevant laws (ibid). For these recalls to be successful, there needs to be a proper method of identification and or traceability available for the foods that have already been distributed in the market (FAO, 2021).

Traceability also involves tracebacks and traceforwards, where information about the origin and destination of foods is traced (IFT, 2020). The Institute of Food Technologists (IFT) outlines how tracebacks and traceforwards are used as standard methods of identification and traceability of foods. Tracing forward means complete information on where foods are going, while trace backwards means complete information of where foods came from. The identification of the point of origin allows for traceability to function as a risk management strategy in market regulation. Traceability is more visible in international commerce as organizations like Codex Alimentarius provide guidelines on traceability standards (ibid). In this project, traceability technologies will also represent any other tracing and cataloguing techniques used to maintain food safety, from production to consumption. This may include using word of mouth from producers or distributors to guarantee safety of food products sold at local and international levels.

Methodology

This thesis is a desk study comprising a review of book chapters, journals and news articles and empirical data. The empirical data is based on first-hand experience of being born and having lived in Zambia for 14 years. These sources will be used to understand the type of food safety systems found in both countries. General data about the history of the food safety governance systems in both countries is from journals and other university websites that provide this history. Data on food safety risk approaches/traceability in each country is from institution websites, journal, and news articles.

Introduction of Science and Technology Studies (STS) Theories

Science and Technology Studies (STS) scholars Sheila Jasanoff, Aaron Wildavsky, Mary Douglas and Xaq Frohlich have presented theories that help understand, situate and analyze how risk culture, food safety definitions, and other factors play into food safety systems and how these factors inform the structures or infrastructures of food. In the introduction of *Risk and Culture* (1983), Wildavsky and Douglas explore the relationship between risk and culture especially in relation to technology and science. They use examples of environmental and technological risks to argue that complex social changes in western countries have led to values that the authors identify as sectarian and that these as values have become more prominent, they have become how issues surrounding risk are addressed. I use this approach to show that particular risk cultures or approaches to what cultures deem as risk shape where and how countries use traceability as a means of reducing what a government or regulatory body deems risky. These definitions of risk differ in space and time and are set by regulatory systems even when they are understood differently by consumers.

Frohlich in “The informational turn in food politics: The US FDA’s nutrition label as information infrastructure” (2017) shows the ways in which the FDA’s nutrition labeling has taken an informational turn in its diet, food and health regulation and how this informational turn has been used as a means of regulating the food market through labels. The informational turn is a movement from food standards to informative food labels. Frohlich’s main argument is that labels are at the center of a legal battle that consists of educational and promotional materials that are present in mass and niche markets. I show, using Xaq Frohlich’s informational turn in US food policy, that the informational turn has made visible niches within the US beef market. I also show that traceability as a regulatory device has brought to light issues of trust and has highlighted certain food safety concerns.

In this and in subsequent chapters, I use Jasanoff’s comparative analytical approach to discuss the factors that have led to the formation of food safety regulating bodies by focusing on traceability of beef. I apply Douglas and Wildavsky’s approach in chapter two and Frohlich’s approach in chapter three.

Why compare? In the introduction to *Designs on Nature* (2005), Sheila Jasanoff develops a comparative analytical approach to show the ways in which politics and policy in the life sciences are informed by both private and public actors, in Germany, Britain, and the United States. Jasanoff makes three main arguments: first, that democratic theory cannot be properly addressed in modern terms without first looking at the politics of science and technology; second, that policies in science and technology in the three countries she explores became involved in nation building at an important stage in their histories; and third, that political culture matters to contemporary democratic politics.

All three of her arguments matter here, but I will mainly focus on her first and second arguments as they show how modern democracies cannot be expressed without understanding their policies on science and technology and how these issues inform nation building. Her approach to studying the influences of these actors on policy and politics provides a framework for approaching comparative analysis studies and also provide an insight into how regulatory systems come to be formed in different countries.

In one of her examples, Jasanoff shows how Germany used biotechnology policy to reinvent its national identity since the two world wars and the Holocaust. She notes how discussions of Europeanization also increased the need to unify Germany and establish nationhood and how issues of biotechnology provided an opportunity to do just that. Jasanoff captures how the social differences in these three countries inform the technological choices used to advance nations and how political decisions are deeply rooted in local definitions of truth/validity. She also demonstrates the value of using comparative analysis to understand and improve policy administrative bodies, a perspective I wish to reinforce in this project. I use her theory to show the ways in which administrative bodies, namely food safety regulatory systems, have differing social forces and factors that heavily influence the making of these systems.

Historical Background and Significance of Study

The History of Food Regulation in the United States. The two countries selected in this analysis have unique polities and histories that shape their respective food safety systems. The United States, though a former British colony, has established methods of food safety regulation that do not resemble those of Great Britain. Until the 20th century, the US had a long history of food regulation at a local and state level that was driven by the needs of international commerce rather than safety (Thomas, 2010). In 1906, two food Acts were passed into law: the Pure Food

and Drug Act and the Federal Meat Inspection Act (FMIA). Both Acts addressed food safety by prohibiting the misbranding and adulteration of foods, providing a foundation on which modern food laws are built upon (FDA, 2018). The Acts helped address the insanitary conditions in the meat packing industry and the use of poisonous substances in foods (Levenstein, 2012). The FMIA has continued to be amended to fit the modern meat industry.

The focus on safety remained largely unchanged, until recent years, when the US introduced the Food Safety Modernization Act (FSMA) in 2011 to address preventable foodborne illness that were becoming a public health concern (FDA, 2018), especially for fresh fruits and vegetables. Before the Act was passed, the number of foodborne illnesses, hospitalizations and deaths was increasing, yet this burden on public health was largely preventable (FDA, 2018). The FSMA allowed the FDA to focus on preventative measures for high-risk food (fruits and vegetables), some of which are imported.

At a local level, the US has informal markets or direct-to-consumer (DTC) markets that are regulated depending on the type of food being sold. These markets include roadside vendors, farmers' markets, etc. In such markets, meats that are sold must be slaughtered or processed at a federally inspected facility to ensure their safety (USDA, 2015). Meats that are sold in these markets must also follow labeling requirements.

Regulation History in Zambia. The Republic of Zambia on the other hand, has retained stronger ties to its British colonial past (Silolo, 2017) in the form of a similar polity and structure of regulating bodies. Zambia's of food safety, however, appears to be much closer to that of the United States in that it also describes how food safety prevents food related diseases. Zambia defines food safety as scientific discipline describing the production, manufacture, handling, preparation and storage of food in a manner that prevents food related diseases and harm (The

Food Safety Bill, 2019). Like many developing countries, Zambia has two main economic market sectors: formal and informal. For purposes of this discussion, I focus primarily on the informal sector as it accounts for about 80% of the food system in Zambia (Mwango et al., 2019). Since this sector is largely unregulated, documentation is difficult to come by as it relies solely on local markets. I use empirical evidence as well as secondary sources to discuss this sector.

When it comes to regulation of the informal sector, the government tends to lean towards formalization (ibid). Interestingly, the government does provide designated locations for this type of market, yet those involved in selling prefer to be on the streets to reach their customers. This means these vendors are constantly on the move as they fear facing harassment from authorities (ibid). Zambia also has a formal sector that is regulated by the government through several authorities and ministries. Some of these ministries include the Ministry of Health, Ministry of Agriculture and the Ministry of Local Government. Food businesses in the formal sector tend to be foreign or privately owned. Some of these businesses include supermarkets or grocery stores. In these formal settings, traceability is documented.

One important law that stipulates how formal businesses are to conduct themselves is the Food and Drugs Act that was instituted in 1972 and amended in 2006 [and later in 2019] (Food and Drug Act, 2006). The Food and Drug Act focuses on a broad range of food and health related issues. For food, the Act outlines topics such as proper handling and preparation, sanitation, proper labeling, public health, food safety, etc. This Act does not specifically mention traceability but outlines labeling specifications. Arguably, this Act enforces traceability in Zambia's informal food sector because it outlines how foods in this sector are to be labeled.

Businesses like Zambeef (Zambia's largest producer and supplier of beef) provide insight into how traceability is used by publishing where it sources its beef on its website and discusses this information further in its annual report. Zambeef's website shows that it sources its beef from five of its farms and also from smallholder farmers (Zambeef, 2020). Zambeef also supplies its beef to other retailers such as supermarkets. Since supermarkets are not easy to get to nor are they affordable for the average Zambian household, informal markets, which include street vendors, farmers, individuals and or families, have bridged this gap by providing affordable foodstuffs at convenient locations (Crush et al., 2011).

When it comes to meat products, (Meat products can refer to beef, chicken, fish, pork and goat products. For the purpose of this discussion, meat will refer specifically to beef products). these vendors usually rely on local farmers and sometimes local supermarkets. These vendors resell the meat purchased from a local farmer or a grocery store at a much affordable price by reselling it in smaller quantities (ibid). An informal market presents an interesting case for traceability systems in that without documentation such as the name of the vendor, the labeling on the food product, one cannot easily trace the original source, unless through word of mouth. Since these vendors may be on the move, it makes it even more challenging to locate them. This shows how the Zambian informal sector uses traceability differently from the US informal sector.

Summary of Regulation history in Zambia and the US

As seen above, these two countries have some similarities but many stark differences in the structure of their food markets and systems of regulation. They can thus provide insight into how countries situated in two different continents came to form their food safety governance systems. They also provide insight into risk approaches and perceptions, especially where meat

traceability is concerned. Regulation of the informal and formal settings in the United States shows a food system that seeks to offer safer foods. However, regulation does not equal safe food as there are instances where preventable foodborne illnesses still occur in the US. The two countries also show how traceability of meat differs. In Zambia, traceability is documented in the formal sectors while in informal sectors it is more complicated as it relies on word or mouth and relationships between sellers and buyers. This comparison between a western country and non-western country demonstrates different approaches to food safety risk and regulation.

Forces that influenced food regulating bodies in Zambia and in the US

Social and political forces in Zambia. For Zambia, the definition of what food regulation looks like is deeply rooted in its colonial past. Following Zambia's independence in 1964, the country moved toward privatization and this greatly affected the food sector. In the Copperbelt Province of Zambia, mines provided employment along with food for workers, but as mines were privatized this led to a wide-spread reduction of mine workers which led not only to a loss in income for these mine workers and their families but also a:

cancellation of provision of food by mining companies, and a liberalized economy that enabled the greater exposure of the cities' food system to global forces ... This profoundly reshaped the food system, shifting both demand and supply. One of the most apparent shifts was the emergence of small-scale and informal food retail as both a means to supply residents no longer fed by the mining companies, and as a livelihood for retrenched workers and their families no longer supported by mining salaries (Fuseini et al. 2018, p. 196).

The birth of informal food retail spread to other parts of the country, creating social opportunities that have continued to this day, including the employment of women and young

people (Mwango et al., 2020). Today, Zambia's direct approach to food safety is newly formed as it only began in 2019 through the introduction of the Food Safety Act (Food Safety Act, 2019). While Zambia does have a history of addressing food safety issues, even during colonial times, it only began to use the term food safety in 2019 (Mbita, 1998 & Food Safety Act, 2019). Colonization also affected the type of food that was consumed in Zambia through the introduction of the Maize crop. It is these kinds of social and political forces that have influenced and continue to influence how food is regulated in Zambia.

For Zambia, the social and political forces that influenced regulation are apparent in the impact of colonization on the markets (formal and informal). Even the manner in which these markets are regulated [or not] shows the influence of the social on the policies used to regulate these markets. The informal markets are much more popular and are not as regulated as it is nearly impossible to regulate individual sellers who are always on the move and account for 80% of the market. Therefore, the Zambian government focuses on regulating the formal sector. This shows how the social setting has played a role in impacting policy on food safety regulation. By comparing these two countries, we see what forces stand out in the modern regulation of food safety and why these approaches to regulation stick.

Social and political forces in the United States. In the US, there are several issues that led to regulation some of which included fears of food arising from the consumption of unsafe foods (Levenstein, 2012). Modern regulation addresses these fears (along with other risks) through the use of science and technology. In 1906, the US introduced two main laws to address food safety: The Pure Food and Drug Act and the Meat Inspection Act (ibid).

The publication of Upton Sinclair's *The Jungle* (1906) which brought to light the ill handling of meat in Chicago by the meat packing industry (ibid) also helped push for food safety

regulation and more scrutiny of the meat industry by the government. This book also helped push for laws that were already in formulation to be passed (ibid). In recent years, the US has sought to continue improving its food safety through the introduction of laws and guidelines on safe food handling. One such important law is the US Farm Bill in 2002 (amended 2008) which enabled labeling for country of origin (COOL) in addressing consumer traceability concerns. COOL emerged at a time when the public was concerned about cases of bovine spongiform encephalopathy (BSE, or mad cow disease) which motivated the adoption of traceability for meat products from farm to fork (Golan et al, 2004) and also at a time when the nation was recovering from the tragic event of September 11. These events, however, are not the only motivating factors to implementing traceability.

Other laws have also been introduced in the US to address food safety, such as the Food Safety and Modernization Act (FSMA) in 2011 and the Federal Meat Inspection Act (FMIA) in 1906. FSMA was introduced to address the changing food system (its diversity and globalization) and to address preventable foodborne illnesses for high-risk foods (FDA, 2018). The FSMA also directly addressed traceability by allowing for the FDA to have mandatory recall authority for all food products (Zach, 2016) and for the FDA to implement additional traceability/recordkeeping requirements (FDA, 2021).

FMIA on the other hand was introduced in 1906 to address the insanitary conditions in which meat was being processed. Though the FMIA does not explicitly address traceability, it prescribes the use of labels and recordkeeping, even though these mainly apply for transactions conducted between firms. This kind of information does help with supply-side traceability and not the traceability that is useful to consumers. Even so, technologies like traceability have

proved useful not only in addressing food safety risks but have also helped prevent financial risk due to losses in food recalls.

Using Jasanoff's framework to understand the US as a democracy, its policies on science and technology show that US food safety regulating bodies were, to some extent, informed by social forces, some including fears of food or financial risks. In the US, fears of BSE and bioterrorism in the early 2000's, along with fears of contaminated food in the 1900's played a role in influencing the formation of regulating bodies and what laws these bodies implemented, even though these were not the only issues that did.

Conclusion and Outline of Following Chapters

This chapter focused on the significance of this study and the approaches that will be used to conduct it. It also showed, briefly how the two countries of interest differ in their approach to food safety. The following chapters cover these topics: Chapter Two describes the modern food safety system history in the US and Zambia and applies Douglas & Wildavsky's (1983) approach to risk culture. It presents what risk culture is and why it applies to this project. It also discusses the modern history of the food safety systems and briefly, their formation. Here, I show how particular risk cultures shape where and how countries use traceability as a means of reducing what a government or regulatory body deems risky. These definitions of risk differ in space and time and are set by regulatory systems even when they are understood differently by consumers.

Chapter three explores the ways in which traceability of beef can be used to understand information infrastructures in food safety, and how traceability has been used as a regulatory device to avoid certain kinds of risk. The main point of this chapter is to further expand on the theory by Xaq Frohlich, namely the informational turn introduced by the FDA and to further

explore this theory applying it to traceability. I show that the informational turn has made visible niches within the US beef market and that traceability as a regulatory device has brought to light issues of trust and has highlighted certain food safety concerns. Chapter four, functions as the conclusion, and brings these arguments together to show how food safety regulatory bodies differ between the US and Zambia.

Chapter 2

Risk Cultures and Meat Traceability

Overview

This chapter examines food safety systems, particularly meat traceability systems, in Zambia and in the United States. It applies Douglas & Wildavsky's (1983) approach to risk culture by describing the social (and other) forces that influence the makeup of food safety systems and traceability. I show how particular risk cultures shape where and how countries define risk. These definitions of risk differ in space and time and are set by regulatory systems even when they are understood differently by consumers. Some of the most important risks in relation to food are environmental concerns, health, harvest methods (humane treatment of animals and processing methods), financial, nutrition, security, and safety, etc. I discuss how these, and other risks have been made visible by traceability.

Traceability systems vary according to the type of food being traced, the type of firms that apply them and the quantity of the product being traced. Fruits and vegetables for example can have bar codes that use Radio Frequency Identification (RFID) technology, a technology that uses radio waves to communicate information about the product (Smith et al., 2008). Meat products can and do use this type of technology as well. For foods like grains, it is nearly

impossible to trace the exact source at certain points of production. Therefore, firms use batch systems of traceability to ensure proper tracking or use analytical techniques such as Near Infrared spectroscopy (NIR) (Kondo, 2010).

Traceability itself is a combination of technologies used to track and trace foods at any point in their production and distribution. In this discussion, I focus on traceability that applies to beef for food safety purposes. Traceability is a combination or collection of technologies; therefore, firms use it for different purposes and for mitigating different types of risk. Two such purposes are to have a well-functioning and integrated firm and to maintain food safety standards. A small-scale firm for example may not be able to afford traceability technologies that are intensive and require tracking of beef products at all levels of production and distribution. Even larger firms cannot adequately and accurately trace food products at all levels of production and distribution. Firms use traceability either where required by law or to ensure a well-integrated food system that avoids putting the firm at risk, based on what this particular firm deems as risky. At a domestic and sometimes even at a global level, traceability is used to address different types of risk, be it financial or health/food safety risk.

Where Traceability Begins

Traceability begins at different levels of production and distribution for different products. For beef/cattle products, traceability can begin pre slaughter with the use of branding and tagging of animals. During slaughter, parts of the animal that identify the animal, like the hide and the ears with tags, are kept until certain stages of processing. Post-harvest, many countries have adopted Radio Frequency Identification (RFID) (Smith et al., 2008). Other methods of tracking include paper and electronic records such as passports, brands, tattoos, tags,

transponders and biometric means of identification such as DNA fingerprinting or iris scanning (ibid).

Traceability in the United States. In the US the FSIS (Food Safety and Inspection Service) regulations require that slaughter plants keep the head and certain organs of slaughtered animals, along with any other parts or organs of the animal that can later be used in its identification. This is because identifying primal and sub-primal cuts of beef is very challenging. DNA fingerprinting technology is one of the few methods that can accurately trace a cut from a specific animal. What DNA fingerprinting cannot do, however, is ascertain the harvest and growth method of the animal—was it grass-fed, organic or antibiotic free? (Smith et al., 2008).

According to Smith et al (2008) as of six years ago there was no compelling reason for the beef industry to adopt the use of DNA fingerprinting, specifically in the United States. Smith further shows how some slaughterhouses can claim to have a well-functioning traceability method especially through labels, but by the time beef products get to consumers, the labels become meaningless (ibid). They may become meaningless since the information found on the labels is not always read and neither is it understood by the average consumer. This not only points to how challenging traceability is but also how it is applied for different purposes. In the US especially, a few consumers may be concerned about the harvest methods of beef products, while an agency like the United States Department of Agriculture may be concerned about the source of these products, especially if a disease outbreak were to occur. In both of these instances, traceability is important and may be applied as a risk management strategy by regulatory agencies.

Traceability in Zambia. In Zambia, animals are branded, and tags and tattoos are used to identify individual animals (cattle). This identity is tied to specific farmers. The Brands Act of

Zambia outlines branding procedures, which are mainly used as a form of establishing property rights (Chapter 244 of the Laws of Zambia, 1913) as opposed to being a means of tracing cattle for food safety purposes. These branding procedures show which methods of branding can be used by farmers to identify and distinguish their cattle from other farmers' cattle. For food safety purposes, farmers in other countries can and do use branding as a means of tracing which farms cattle came from in case of a disease. In Zambia, only a few farmers can supply their cattle commercially to large corporations even though these corporations may purchase their beef from smaller farmers as well (Zambeef, 2020). Small farmers also tend to sell their beef to local and smaller butchers. These butchers conduct visual inspections of the carcass, looking for any defects and signs of disease. At such a level, traceability is not an immediate concern. Based on personal experience, my family was able to supply beef and pork to local butchers who conducted visual exams of the products we supplied them. These butchers merely asked how much per kilogram the products should be sold for.

Meat Traceability as a Form of Risk Culture

In the introduction of *Risk and Culture*, Mary Douglas and Aaron Wildavsky address the relationship between risk and culture in technology and science. Douglas and Wildavsky use examples of environmental and technological risks. The authors argue that complex social changes in western countries have led to values that the authors identify as sectarian. They associate three positive commitments with these values, including human goodness, equality, and goodness of mind and heart. Their main goal in addressing these values is to show that they have become more prominent in many western countries and that the manner in which issues surrounding risk are selected are based on social forces that underlie these values.

Douglas and Wildavsky argue that it is these social forces that aid countries in their path to development when addressing questions about acceptable risk. In this manner, cultural approaches shed light on how common agreements relate natural dangers to moral defects. The authors explain that dangers are selected for based on the strength of social criticism. This criticism is of those in power and how they regulate and on what they regulate. For example, if the public strongly cares about the dangers associated with environmental pollution, regulators implement proper regulation of environmental pollution.

The authors further show that in matters of risk, the choice of which risks should be prioritized is a political decision and a distinct message about who should rule and what should matter. These risks are ranked based on what is perceived as dangerous and based on the values and belief systems discussed above. To further this view, I discuss how firms can have specific risk cultures and thus have specific risk perceptions that reflect the firm's values. Firms that regulate or process food might thus act in ways that reflect their consciousness of the importance of having safe food-- a value that is often significant for the public. As Douglas and Wildavsky point out, risk cultures are not only based on social forces but on power and/or political forces. I discuss below how these political forces have also played a big role in framing the risk cultures of both Zambia and the United States. I also discuss how traceability, as a technological device has been used to mitigate risks that firms and regulatory bodies deem as important.

History of Food Safety (Un)Regulation on Traceability and Risk Assessment

Traceability and risk in Zambia. As described in Chapter one, the food industry in Zambia is largely unregulated in its informal sector. This informal sector is comprised of vendors who are usually individuals and sometimes families. These vendors sell beef (and other foods) on the street and most of their products are "sourced from farmers, but.... most of these

purchases might not be direct, but rather carried out by intermediaries on behalf of farmers. The...vendors state[d] that they source their products from middlemen or fellow traders” (Mwango et al., 2020, p.12). If beef and beef products were to be traced, it would be done via word of mouth and as seen here, the sale of these products goes through intermediaries which makes it even more challenging to trace foods to original sources.

Because these vendors sell a variety of products, they go through many intermediaries and may not have a proper method of tracking and or tracing their food sources unless through word of mouth. Based on personal experience, for buyers and vendors, word of mouth is one where consumers consult with vendors directly if they wish to know more about the beef they are purchasing. This may include asking the vender the name of the farm/farmer or where the seller bought the piece of meat they are selling. Even so, the government has put in place regulations that broadly stipulate how these vendors are to conduct their businesses (Mwango et al., 2020), but none of these are requirements deal with traceability. This is because traceability is not viewed as a risk mitigation tool in the informal food sector nor is it tied to mitigation of other risks that may be perceived in this sector. However, vendors in this sector may from time to time use traceability via word of mouth in instances where food quality is in question. For example, if beef sourced from a particular farmer is diseased and can be visibly seen, vendors will refrain from purchasing from this farmer.

Zambia also has a formal sector that is regulated by the government along with other authorities. This formal sector dates back to the colonial times, when businesses were owned largely by the colonial government. Private ownership of food businesses has since come to dominate the formal sector of Zambia’s economy. One of the largest agribusinesses and beef retailers that emerged in post-colonial Zambia is Zambeef. Zambeef not only supplies meats

(beef, pork, chicken) to other retailers within and outside Zambia, but has also reached concessional agreements with other retailers and is one of the most well-known and trusted meat suppliers in Zambia (Almas & Obembe, 2014). Zambeef sources its products from five of its own farms and also from small and local farms (Zambeef, 2020).

Interestingly, Zambeef's website discusses risk management strategies, all of which point to the economic impacts of unmediated risk. For example, under the risk section of the website, Zambeef asserts that:

the Group risk assessment has highlighted foreign exchange and interest rate risks as high impact risk areas on the business, and this has been duly noted in the Company's debt reduction and efficient cash management strategy, which forms part of the current business plan and corporate strategy (Zambeef, 2020).

The website does not discuss the risk associated with food safety, showing that Zambeef focuses on the risk associated with debt and cash management. This may also point to the fact that the risk associated with food safety is not a matter that has to be outwardly stated because Zambeef is already addressing this issue as a company cultural practice. As stated above, Zambeef is very well known and trusted by the public. Zambian consumers rarely question the safety of meat supplied by Zambeef, unless the media portrays the company negatively (Almas & Obembe, 2014). Even so, food safety is not a risk that Zambian consumers are particularly worried about (Hakobyn, 2014). Unlike American consumers, Zambian consumers are not concerned about the harvest method but are concerned about affordability and visual signs of quality and or safety.

Zambian consumers who purchase beef from vendors on the street are already aware of the risk associated with buying from an individual vendor, i.e., the sanitary conditions in which

the beef is being sold and the possibility of contamination (Hakobyn, 2014). Even so, these consumers choose to buy such products because of affordability. The Zambian government does regulate the conditions in which such products are sold. This regulation, however, becomes more pronounced during *riskier* times of the year, namely when cholera outbreaks are common. Regulation here involves getting vendors off the street to prevent consumers from purchasing contaminated beef (and other foods). Several authorities such as the Zambian army and the Ministry of Health step in to contain the spread of cholera by getting vendors off the street (Maingaila, 2017). These authorities also collaborate with agencies like the World Health Organization (WHO) and Africa Centers for Disease Control and Prevention (Africa CDC) to provide clean and safe water (CDC, 2018).

As mentioned above, financial/currency risk is the most prominent for food retailers in the region as the currency is unstable which greatly affects businesses. Zambeef does not discuss how its traceability system functions in its annual report. It does however show that it has a traceability system that helps its business remain integrated and well-functioning in that it keeps a record of its farm sources of beef animals. Zambeef's annual report shows that the business strictly follows safety procedures and mitigates food safety risks by implementing occupational health and safety practices (ibid). Some of these practices include training its employees on food safety and handling of hazardous materials. These kinds of risk are therefore not as pronounced as financial risk.

As discussed above, Zambia focuses on financial risk due to the instability of the currency. This risk is also reflected in society more broadly in that most consumers are concerned with availability of meat and its affordability as opposed to its safety. This risk frame is true for both the informal and formal sectors in that both focus on the financial risks associated

with the sale of meat as opposed to its safety. For the informal sector, consumers trust the person selling in that they do not usually question where a product came from. The same applies to beef from Zambeef, as long as it is labelled as such, consumers do not question its safety. This social and/or cultural frame has driven the kinds of risks that businesses and firms have adopted in the Zambian market. The Zambian public also tends to trust institutions due to cultural perception of authority.

According to a study conducted by Afrobarometer, most Africans trust institutions based on leadership: “If people think that officeholders are honest, they are likely to deem the institution trustworthy– and vice versa if they think officials are self-serving” (Afrobarometer, 2016, p.1). Africans also tend to trust local and less formal leadership. What makes the case of Zambia even more interesting is the fact that 55 percent of Zambia’s population is illiterate (Adsum foundation, 2011). With more than half of the population not being able to read and write, questions of trust in institutional leadership become much more challenging but also make the cultural perceptions more pronounced since culture does not require literacy.

Traceability and risk in the United States. In the US, traceability in food regulation was formalized a decade ago. With the introduction of the Food Safety Modernization Act of 2011 (FSMA), traceability regulation became more widely used in policy circles as the need to trace foods due to fears of bioterrorism became more pronounced. Most of the literature points to this as the beginning of much scrutiny and attention to traceability, even though the main focus is the economic value of traceability systems. In the United States firms “build traceability systems to improve supply-side management, to increase safety and quality control, and to market foods with credence attributes (attributes that are difficult for consumers to detect, such as whether a food was produced through genetic engineering)” (Golan et al., 2004, p.3). Fears of bioterrorism

became more pronounced following September 11. This tragic event reframed how institutions regulate and what they regulate. For the food sector, this meant realizing that terrorism could occur in this sector and so regulation needed to address and prevent this. The public also expressed fear of terrorism, and traceability proved to be a useful tool to counter such fears. According to a report prepared for Congress on the effects on 9/11 on the economy, the author, Gail Makinen, refers to this fear of terrorism as a “crisis in consumer confidence.” The author also discusses how the Food and Agriculture sector was also affected in that the United States realized its vulnerability to bioterrorism within this sector. In this manner, bioterrorism became a cultural fear that political leaders selected for in their regulation in that both the public and the government saw the need to have regulation that addressed bioterrorism.

The meat/beef sector in the US, however, has had a long history of informal tracing of animals, mainly to prevent the spread of disease (Golan et al., 2004). Some of these methods have included branding of beef animals. The relationship between tagging and branding of animals to tracing of beef/meat products is very complex in the US. While the United States Department of Agriculture (USDA) does require keeping certain parts of the carcass for traceability purposes, there is no direct relationship between tracing a live animal vs tracing the carcass or beef product. This is because traceability is a complex system in general: “even a hypothetical system for tracking beef, in which consumers scan their packet of beef at the check-out counter and receive information on the date and location of the animal’s birth, lineage, vaccination records, acreage of pasturage, and use of mammalian protein supplements, is incomplete” (ibid, p.3).

For certain US consumers, information like the lineage and vaccination history are important especially for health purposes. Other consumers may also be concerned about the

direct impact of food consumption on the environment (Nguyen et al., 2019). Some consumers also wish to know this information to support businesses that do not use certain hormones and businesses that use cattle that yield organic beef. Information on harvest methods presents a financial risk for firms as they understand their brand image matters to consumers. It is because of these differing risk frames and situational factors that traceability has to be specific to a particular point in the supply chain or even during processing.

For Ngyugen et al (2019), these situational factors are tied to how consumers perceive organic and or environmentally friendly meat products in that these situational factors are also relevant to consumer public health concerns. Already, these situational factors show the benefit of tracing beef back to the harvest process. They also show the differing reasons for having a traceability system for both consumers and firms. From a food safety standpoint, both consumers and firms are also equally concerned with traceability even though the burden of having such a system in place lies with the firm. This is because firms are required to have such a system in place (though not intensive) while not every consumer is concerned about the safety or the harvest method of the beef they consume, and neither are they in a position to require or implement traceability even though they can apply political pressure for firms to implement traceability processes. Intensive here refers to having a thorough traceability system which is not required by law especially for foods that the Food and Drug Administration (FDA) does not consider high-risk. High risk foods according to the FDA list include cheeses, leafy greens, fruits, etc. This list does not contain beef as a high-risk food as it is under the United States Department of Agriculture (USDA)'s jurisdiction. Processors are minimally required to have traceback information or keep records of where they source their beef animals.

Different types of beef are traced differently in the United States. For comminuted beef, processors can source their animals from different farmers and countries and can combine these products into one product. Even beef products sourced outside the United States can be labelled as “Product of US” if they were merely processed here. This is especially misleading in traceability that is consumer friendly (like labeling) as it does not tell the consumer the original source of the product. Under COOL (country of origin labeling) regulations in 2013, the USDA has been trying to put in place regulation that requires labeling where an animal was born, raised and slaughtered. Thus far, though, it has failed to do so because Mexico and Canada under the World Trade Organization (WTO) rules stated that this requirement would be economically burdensome to them (Federal Trade Commission, 2020). COOL labeling was established (in 2002) to help consumers identify the country of origin for certain products including their harvest methods and how they were processed. COOL law is required for retailers such as grocery stores and club warehouses. COOL labeling includes having labels that state the name of the country or origin and information on how the product was processed such as hatched, grass fed, etc. COOL was signed into law at a time when Bovine Spongiform Encephalopathy (BSE) cases were rampant (USDA, 2020).

The WTO under its Sanitary and Phytosanitary Measures (SPS agreement) does have provisions for countries to impose trade-related considerations related to health (WTO, 2002). These considerations state that measures should not unjustifiably discriminate against trade partners so as to restrict trade. Where traceability is concerned, such a consideration makes it difficult to impose regulations such as COOL, as seen in the case of the US vs Canada and Mexico. For traceability purposes, COOL labelling for beef products would be advantageous to consumers who wish to know the true origins of a meat product and for producers to verify

whether a meat product was harvested humanely, grass fed or certified organic (Crandall et al., 2013).

For regulatory bodies in the US, high risk foods tend to be fruits and vegetables (FDA, 2020) and therefore warrant a risk-based approach to food safety such as traceability. As for beef/cattle products, the Federal Meat Inspection Act (FMIA) of 1906 (amended 2014) prohibits the sale of adulterated livestock and ensures sanitary slaughtering procedures. The Federal Meat Inspection Act (FMIA) does not explicitly mention tracing or traceability. Instead, the Act mentions recordkeeping (which is a form of traceability) which mainly applies to transactional records. This shows how use of the word *traceability* is relatively recent and how it is still in its infancy in the meat industry. The Bioterrorism Act of 2002 reveals a more insightful background of traceability. The Act itself does not mention traceability, but under its guidance for implementation by the Food and Drug Administration (FDA), the Act states that all restaurants and food facilities are to be registered with the FDA as “registration will help provide FDA with information on the origin and distribution of food and feed products and thereby, aid in the detection and quick response to actual or potential threats to the U.S. food supply” (FDA, 2006), alluding to a form of tracking and tracing.

For meat products, the Bioterrorism Act expands the roles of the USDA’s Food Safety Inspection Service (FSIS) to inspect international meat products at the point of entry and point of origin (BTA, 2002). Though the guidelines focus on adulteration, they also show how regulation on traceability is broad yet, can be applied to more specific types of foods. It further shows how emphasis on traceability is placed on preharvest procedures and not so much post-harvest. In 2020 however, the FDA amended FSMA to include more specific requirements for traceability such as additional record-keeping for riskier foods like fruits and vegetables.

Looking at Tyson Foods, one of America's largest suppliers of beef shows that its approach to food safety varies greatly compared to Zambia's Zambeef. The Tyson website for example, states that "Our Food Safety and Quality Assurance Team is passionate about making great food safe. Safe food requires a culture that puts safety first. This means responsibility for food safety lies with everyone from the plant floor to the CEO's office" (Tyson, 2020). Unlike Zambia's Zambeef, Tyson directly addresses its food safety policy.

Traceability as a Risk Management Tool

In Zambia and the United States, disease outbreaks in beef animals have provided a motive to trace the animals themselves to maintain a disease free and a sound food safety system. This is especially the case for zoonotic diseases and diseases like mad cow which affect human beings. Arriving at this 'sound' food safety system is not straightforward as it involves mitigation of risk and defining which risks deserve to be addressed over others. One cannot simply reach a point of absolute food safety as there is always room for improvement.

The BSE cases (bovine spongiform encephalopathy) that caused the recalls in the US have highlighted the importance of traceability systems and not just in one sector of the food industry. In 2008 for example, 143 million pounds of beef were recalled even though there were no confirmed illness due to the threat of BSE (FSIS, 2008). With the earlier BSE cases in 2003, the secretary of agriculture implemented a program that identified the diseased animal within 48 hours of discovery (Becker, 2007). This was done to mitigate risk that was observed with the BSE cases. Since then, the US has implemented these programs in all states (ibid). On a social level, consumer groups have expressed concern over the BSE cases (Coffey et al., 2005) as they were widespread in the media. To a certain level, consumers have also played a role in pushing for consumer-friendly traceability systems such as bar codes that point back to harvest methods

in retail settings. In wanting to know the harvest methods of beef, consumers have also influenced firm accountability and transparency since some firms have based their brand image on being able to trace their beef back to specific farms and to specific harvest methods that are certifiable.

Risk management, as a component of food safety has since become very important, especially in the United States. For example, when there is a common food-borne illness, traceability comes in handy in allowing for the source of the contamination to be determined. Without traceability, this identification of the source of contamination would be difficult. Another example of this is when in 2006 Canada reported its sixth case of BSE and part of its investigation was to trace the affected animal's offspring. Since the United States imported beef cattle from Canada, such an investigation was important as the US could temporarily block imports from Canada (Becker, 2006). In these examples, managing risk means containing the spread of disease using traceability.

As mentioned before, the definition of risk is dependent on the type of risk and how the regulatory bodies define it. Both the United States Department of Agriculture (USDA) and the Food and Drug Administration (FDA) implement risk management programs through traceability programs, though sometimes voluntary. As seen in FSMA, importers of food can choose to participate in programs that trace food products (FDA, 2020). This shows how both the USDA and the FDA perceive this risk as not too burdensome by making it a voluntary. It also shows a kind of emphasis on the importance of economic gain and or economic risk-- if more importers are tasked with applying traceability procedures, they may not be able to participate in trade with other countries, limiting economic gain.

As Douglas and Wildavsky show, there is a ranking of risks involved with each government and in this case, regulatory body. The authors call this risk assessment. In the case of the US, the FDA has a food traceability list where foods (mainly fruits and vegetables) are ranked according to level of risk. The FDA also mentions how this risk assessment was created in consultation with the public. The BSE cases and major recalls related to beef have also seen the application of traceability methods used for fruits and vegetables to be used for beef. In Zambia, ranking of risks is evident with prioritization of financial risk over food safety risk, especially in the formal sectors. The informal sector uses traceability to ensure quality of beef. It also prioritizes disease prevention.

Other Roles of Traceability and Chapter Conclusions

Because the United States market is extremely large, traceability has played a role of accountability for firms and businesses. It has also created market opportunities for firms and businesses who identify themselves as being sustainable, environmentally friendly or even organic. If consumers wanted to know how sustainable or environmentally friendly a business is, they would use traceback systems such as barcodes and labels (organic, non-GMO, etc.) --- tools that are readily available to them. In this manner, consumers are not doing the tracing themselves but trust that for an item to bear any one of these labels, it must have passed through certified methods of regulation and approval, especially for certifiable information like organic.

In terms of food safety, traceability would also function as a means of assigning blame in case of an outbreak and to also prevent further damage by consumption of contaminated products. In this manner, traceability has been used to treat only a particular set of risks and not others, as discussed above. In the case of Zambia, traceability has played a far less dominant role, even for riskier foods (Riskier foods universally tend to be ready-to-eat foods, perishable

foods and undercooked foods. (Zambian consumers tend to cook majority of the foods they consume, reducing the risk of consuming microbiologically contaminated food. (Zambian consumers also tend to consume less dairy products). Traceability has mainly been used by vendors and industry (Zambeef) and not so much by consumers, to maintain a well-functioning food system.

As Douglas and Wildavsky point out, what drives these choices of risk prioritization is power and social criticism and the strength of this criticism. In a sense, what society prioritizes or are concerned about ends up becoming what is prioritized by regulators. In this case, United States consumers care about the safety of the food they consume due to [negative] historical associations of science and technology and have therefore applied pressure for regulators to amend how food safety issues are regulated. When it comes to trust in food institutions, Americans generally distrust food manufacturers (Lang, 2013). This refers to the fact that the US public generally has a distrust of institutions and of science and technology. Authors like Hashemzadeh (2019) point to the Second Great Awakening in the 19th century as the beginning of American distrust in science. This distrust has continued to this day and can be observed in the necessity of auditing systems and even at the very core traceability. For Zambian consumers, the negative history of science and technology does not exist. Instead, consumers trust both individuals and firms. This is especially evident when consumers do not question the source of beef, especially from Zambeef.

These examples of Zambia and US have shown that risk management and risk mitigation are defined by food regulatory agencies within each country and sometimes by consumer perception of this risk. Even the definition of traceability differs within the contexts of these two countries. For Zambia, traceability does not exist as a consumer accountability tool for firms as it

does in the US. For US consumers, traceability has to be much more intensive and further than a brand name in that some consumers are interested in knowing the harvest methods, while in Zambia consumers are content with knowing simply that the beef was produced by Zambeef. This points to the cultural frames through which consumers and in turn regulatory bodies have interpreted risk. Even so, it is the regulatory bodies that have shown whose definition of risk matters the most.

Using Wildavsky and Douglas' approach to risk culture, the United States has seen a stronger social criticism of its scientific/food institutions. This is seen where the public mistrust in science and other institutions establishes systems that make such institutions credible in the eyes of consumers. This has not been the case in Zambia because the American public has associated or perceived more dangers within their food system than have the Zambian public. These dangers have also seen traceability as a possible solution. Perhaps the Zambian public could also associate the same dangers were it not for financial issues.

Chapter 3

The Informational Turn in Food Safety Regulation

Overview

This chapter explores the ways in which traceability of beef can be used to understand information infrastructures in food safety, and how traceability has been used as a regulatory device to avoid certain kinds of risk. I show, using Xaq Frohlich's informational turn in United States food policy, that the informational turn has made visible niches within the US beef market. I also demonstrate how traceability as a regulatory device has brought to light issues of trust and has highlighted certain food safety concerns. Finally, I discuss how the Zambian beef market compares to the US beef market.

Information Infrastructures in Food Safety

Xaq Frohlich, in "The Informational Turn in Food Politics: The US (FDA)'s Nutrition Label as Information Infrastructure" (2017), discusses the ways in which the Food and Drug Administration (FDA)'s nutrition labeling has taken an informational turn in its diet, food and health regulation. The Informational turn is the movement from food standards to informative food labels. Frohlich notes how before this informational turn, the FDA sought to differentiate the food market from that of drugs mainly by prohibiting the use of drug information on food labels, reasoning that this information would not be understood by the average consumer. According to Frohlich, food labels reemerged in the 1990s as a means of solving information overload and to better regulate the market through consumer information. Frohlich's argument is that food labels (as information infrastructure) are "situated at the center of a legally constructed terrain of inter-textual references, both educational and promotional, that reflects a mix of market pragmatism and evolving legal thought about mass versus niche markets" (Frohlich, 2017, p.1).

He goes on to explain how changing the label produces information that goes out to an already existent informational infrastructure, yet has material consequences in the consumption, production and distribution of food.

This is especially seen where nutritional labels become more performative rather than descriptive and have more power to frame markets. For example, companies are forced to reformulate their product recipes to avoid triggering new label categories and markets themselves react based on what is on those labels. Regulators expect consumers to use the information they are given to make decisions that better serve them. In this way, the market is regulated indirectly. Frohlich's main point by examining this is to further explore the STS argument that there is no easy technological fix to [informational] politics problems and to show how the informational turn in food labeling has allowed for the creation of new markets within the main market and have also allowed for convenient accounting devices.

I use this approach to argue that traceability, as an aspect of information infrastructure and as a technology, has been used to regulate markets and has also exposed niches within beef markets. Traceability has shown how food safety regulation highlights certain safety concerns while downplaying others.

Traceability As Information Infrastructure

Frohlich shows how information has been understood and used to regulate United States' food markets, and how regulators have sought to regulate information. He shows how this information is produced, regulated and consumed, focusing on the broader framework/infrastructure of this information of food. Traceability as one strategy within this broader framework of information itself incorporates several information infrastructures in the

food market. For example, vegetables, fruits and grains each have their own way of being traced, understood and regulated. In this discussion, I focus on beef traceability infrastructures.

Frohlich shows how it is also easier to observe who the main players are in a market that is informationalized. He states that “food as information can be objectified, abstracted, and decontextualized such that it circulates more easily, and can be used to coordinate and link together heterogeneous markets in ways that cultural knowledge cannot. Information on labels is also easier to regulate” (Frohlich, 2017). Here, Frohlich shows how the move towards informationalization functions in the United States context—that food has been reduced (reductionism is the idea of focusing on individual components of a whole). An example of this is nutrition reductionism where the focus is on individual food components such as proteins, vitamins etc., as opposed to focusing on the health aspect of food and eating patterns, so much that it has become information and has taken a form that is much easier to regulate. In a way, the move towards informalization has displaced or relocated issues of trust from local sellers to the information infrastructures themselves.

In the distant past, consumers trusted local butchers and sellers for their supply of beef (Frohlich, 2016). Soon this trust would be diminished due to the publication of works such as *The Jungle* (1905) by Upton Sinclair that criticized the meatpacking industry and its ill handling of meat. Later on, trust in food institutions would be challenged again, this time through BSE scares in the 1990’s and early 2000’s, some of which caused major beef recalls and the tragic event of September 11, 2001. These and many other events, along with other food recalls, pushed producers and regulators towards traceability systems not just for food safety purposes but also as devices of trust and as a means of affixing national security. For consumers, traceability (through labels) helps establish and maintain trust with brands. Consumers can

simply look at a label and know enough about a brand without having to do research on it every time they pick-up a product. In an informationalized market, labels have become the site of (mis)trust, as there is an excess of information. This has placed the burden on producers and regulators to meet consumer needs of trustworthy information, such as the source of beef products or lineage information, etc. It has also made it easier for regulators in that they can now standardize this ‘information’ which makes it easier to regulate. Beef products can now easily meet these standards or not.

This does not, however, mean that beef markets have, in their entirety, shifted to an informationalized system as older frameworks of trust and knowledge are still at play. This means that there still exists an embeddedness or overlapping of infrastructures of the old and the new. When it comes to beef traceability, it has meant that the way in which beef has been traced before the emergence of labels still exists in today’s market. For example, beef animals have long been tracked through tags, brands or tattoos before the emergence of Radio Frequency Identification (RFID) or other electronic means of identification.

The emergence of newer means of traceability have not eradicated these methods (Becker, 2005). This is because tags and brands are necessary, especially in trade to identify not just the location history (what ranch/farm/country the animal came from) but also the health history of the animal. Having this information available helps contain the spread of disease in case of an outbreak and also helps facilitate food recalls. The FSIS also requires keeping these forms of identity during processing until a certain stage of processing is completed.

Newer traceability technologies. Today, one of the most sophisticated methods of traceability of beef is DNA fingerprinting. DNA fingerprinting uses the DNA profile from an

initial sample taken from the animal. This method of identification, which can be used at any stage in the processing of the animal (Ureña et al., 2004) is the most reliable and effective means of identification and tracing of a beef animal. This method of traceability is also very rarely used as it is very costly. Such precise methods of identification have also not been viewed as necessary by firms because they are not mandatory. Golan et al (2004) note that regulatory bodies may consider requiring traceability to increase food safety, even though such a requirement would be burdensome and may not work well with private traceability systems that are already in use and are efficient (Golan et al., 2004). This shows how difficult it is to have a standardized and centralized system of tracing food.

Another notable state of the art traceability system is blockchain. Blockchain itself is a block of data that is linked together in chronological order through a network (IFT, 2018). This data is secured by cryptology and allows for a decentralized traceability system with each producer or manufacturer being able to input secure data into the blockchain system. Some issues with a:

centralized system to traceability includes a single point of breakdown, the opacity of such a system, and basis on the trust of the provider. Blockchain has the potential for disparate parts of the food supply chain to input data into a shared ledger that reaches both ends of the market, from producer to consumer (Ibid, p.1).

This way, companies can put in traceability information and keep their propriety information safe. The use of blockchain is still in its infancy but has been implemented in some pilot projects (ibid). Blockchain promises a secure and easier way to manage traceability information. These types of traceability show how information travels within food markets and how there are several information infrastructures within these markets.

Functionality and Situatedness of Labels

Beef labels contain several types of information namely the percentage of fat, the product name, safe handling instructions, weight, ingredients and the inspection legend (American Meat Association, 2015). With these and other features, labels can play different roles for consumers and for regulatory agencies. In the case of beef, the United States Department of Agriculture (USDA) plays a vital role in ensuring that the information that appears on the label adheres to labeling policies. When it comes to traceability of beef, this kind of informationalization (of placing at least five features required by the USDA on the label) plays an important role in informing the consumer about the beef product. This informationalization also makes traceability important as most of these features point back to how a beef product was processed or grown and harvested. The percent fat of a beef product for example, points back to how the cattle was grown in that to achieve a certain weight on a steer, it has to be fed or grown under a specific diet (US Beef grading, 2012).

Labels, in the United States context, as noted in the previous section, are situated between two infrastructures in regulation. In these two infrastructures, labels either play a role of displacement or are additive. They are additive in that they have introduced a new market and a new form of regulation of this market, namely a regulation using information. In their displacement role, labels have relocated trust by connecting labels to brands. Labels in this manner have also been the site of trust especially in cases where beef products have certified organic or any other certifications on them. In their additive nature, labels have introduced (or made visible) a kind of niche market that is centered around information on the label and its significance.

As a displacement tool, labels have placed consumer trust not in regulators but in brands/labels themselves. In a way, consumers have also placed indirect trust in regulatory firms and agencies because these agencies are responsible for certifying that certain qualities of beef products meet a certain standard which appears on the label. When it comes to traceability, this has meant that regulators, through third party auditors and certifications, have used labels to provide information that they deem as useful to consumers. This is where labels have brought together manufacturers/firms, consumers and regulators. Since labels are built on pre-existing infrastructures, issues of trust in the older infrastructure are still existent in that consumers are still able to purchase beef at a local level through farmer's markets or roadside sellers (USDA, 2020).

Labels/traceability as regulatory devices to avoid risks. With the advent of informationalization with labels, regulators have sought to avoid food safety risks by standardizing what labels should look like or what information should appear on them. Information like manufacturer's name and address are useful in instances of recalls. The United States Department of Agriculture (USDA) has a list of mandatory features that every label should have: Product name, handling statement, legend / establishment number, net weight statement and the safe-handling instructions (USDA, 2013). These features are not only helpful for some consumers to identify what the product is but are also helpful in traceability.

Even within informal settings, the USDA implements food safety practices using information. The USDA states that for farmers to participate in farmer's markets they must "comply with the regulations within their respective state including regulations pertaining to the harvesting, food preparation and safety, and labeling of products within their respective states for

products that are brought to and sold at the USDA Farmers Market” (USDA, 2019). This labeling of products shows the significance of traceability for food safety purposes.

Creation of New Markets Within Markets

How much has informationalization created a market within a market or made visible niche markets? In beef traceability, informationalization has created a market within a market in that there exists a space for different types of beef within the dominant market. For example, a beef product may be labeled as being organic while another may not.

Caswell (1998) notes how consumers make purchasing decisions based on how a particular food was processed. Caswell further notes that consumers, due to their different preferences choose food based on risk levels as well (Caswell, 1998). This is one example of how niche markets have emerged out of informationalization and how traceability has exposed or made visible these markets. Traceability has also served as an important tool in proving harvest method of beef. Before informationalization, consumers would not be able to make these kinds of decisions. Tools like traceability through informationalization have also allowed for these preferences or niches to become more pronounced.

A well-functioning infrastructure is neither seen nor is it tangible, yet its effects are. When it comes to traceability however, it seems that the behind-the-scenes actions, especially related to beef processing, are brought to light through informational labeling. This dictates the direction of the new informationalized market to some extent (Caswell, 1998). Frohlich notes that manufacturers are forced to adhere to the information on the label and adjust to consumer trends. An example of these effects is how manufacturers have had to reformulate their recipes so as to reduce the sticker shock or the sudden increase in price due to value for consumers (Frohlich, 2017).

Some consumers have stuck to their older means of purchasing beef through local and informal settings. Even so, regulation has generally used an informationalized approach by still implementing standards, even within local or informal settings. The United States Department of Agriculture (USDA) guidelines for farmer's markets states that "producers must provide to USDA Farmers Market personnel...a list of all menu items and products to be sold including ingredients for each product along with the name(s) of the farm(s) ingredients are sourced from to meet the Producer requirement" (USDA, 2019). This applies to all farmers markets and points to the significance of traceability, even within informal settings. Farmer's markets in general are also subject to food safety laws within their respective states.

Informationalization [through traceability] has made it possible for consumers to make choices, which were not possible before the informational turn. For example, consumers now have information on organic and non-organic. These kinds of niche markets can to some extent influence the use of traceability by producers.

Informationalization in the Zambian Context

While Zambia may not have necessarily gone through an informational turn, information about food through traceability has some similarities but largely differs from that of the United States. This is true for both informal and formal sectors (as discussed in chapter one) which both have their own kinds of information infrastructures. Zambian consumers have largely been dependent on word of mouth as a form of traceability. This word of mouth is especially common within informal settings (Mwango et al., 2020). Here, labels do not exist as a material means of traceability. This is not to say that labels are not useful for traceability but that they are not as much used as the labels in the US context possibly due to literacy of consumers and reduced instances of food recalls or as a form of food safety within informal settings. Zambian consumers

place trust in individuals who sell these products. It is important to also note how the availability or consumption of beef is distributed within the *Zambian market*. According to *Sichilima et al. (2015)*:

Zambeef commands 48 per cent of urban beef sales and 24 per cent share of the national beef market. Butcheries have a market share of 66 per cent whilst the informal market has 22 per cent. Butcheries and the informal market are the major retail outlets for meats while supermarkets account for only 8 per cent market share (*2015, p.412*).

This means the average *Zambian consumer* is likely to purchase their beef from an informal market. As discussed above, foods purchased within informal settings rarely bare labels, instead, consumers rely on word of mouth to communicate information about the product. Another important aspect in the informational infrastructure of beef in *Zambia* is the diet. The *Zambian diet* mainly consists of maize and legumes while animal sourced protein plays a minor role in the diet (*Mwanamwenge & Harris, 2017*). Other factors such as affordability also play an important role in diet (*Sichilima et al., 2015*). In a way, this lack of diversity allows for information about these products to be less complex in that there are fewer players in the infrastructure of beef compared to widely consumed foods like maize.

When it comes to the formal sector, information about beef is much more readily available than it is in the informal sector. This is because food labeling is mandatory in the formal sector. *Zambia's Food and Drug Act* outlines how meat and other foods are to be labeled and how mislabeling is punishable by offence (*Food and Drug Act, 2006*). This Act was passed in 1972 but was amended and consolidated with an earlier law in 2006.

In both the *United States* and *Zambia*, there seems to be a dominant infrastructure that is less regulated by information and a sub/niche market that relies on information on labels. For

Zambia, this submarket is the formal sector where foods are required to have labels, including beef. For the US, this submarket are the niche markets within the beef market.

Arguably, Zambia's information infrastructure appears to be more hidden (especially within informal settings) than it is in the US, in that Zambian consumers do not request additional information such as processing or lineage history of beef products while some US consumers do. This shows how traceability brings to the fore issues of trust and accountability within informational systems of certain countries.

Chapter Conclusion

This chapter has shown how information infrastructures differ in space and time. It showed how information has been used as a regulatory device specifically through traceability. This chapter also showed how in the US context, traceability was relevant to consumers within certain markets, even though it is required in all market settings. The Zambian market showed how information about beef is more readily available within formal settings and how this information is regulated. In a Western country like the United States, technologies like traceability bring to the fore issues of trust by bringing to light infrastructures that would otherwise remain hidden. Perhaps Zambian consumers would also be concerned about how their beef products were processed were it not for issues like affordability, availability, and literacy.

Chapter 4

Conclusion

Chapter Overview

This chapter provides concluding remarks and analysis of the topic. I focus on the main arguments from previous chapters and provide analysis of the main differences and similarities. I also discuss why this study is important.

Significance of Study

Studies on food safety systems have focused primarily on regulation, but not on the significant issue of traceability. Starting with a brief history of the modern food safety regulatory systems in Zambia and the United States, this study explored why these systems take the shape that they do and also how traceability plays a role in food safety regulation. This study used Sheila Jasanoff's comparative analytical approach to observe the differences and similarities between the United States and Zambia. Jasanoff's approach also provided insight into how governmental approaches to national development are intertwined with approaches to science and technology and how the policies used here are informed by both private and public actors.

Zambian context. For Zambia, the modern regulatory system is deeply rooted in its colonial past. The colonial system not only influenced the type of food that was consumed but also how this food was regulated. Chapter one showed how the privatization of mines greatly influenced the formation of markets (formal and informal). Even the organization of regulating bodies was shaped by the colonial government. It was largely these political forces in Zambia that influenced science and technology policy. This influence is seen in the adoption of colonial government policies in regulating bodies. The use of systems like parliament and the appointing

of Ministerial leadership to govern scientific (and food related) bodies is heavily influenced by the British colonial government.

The lack of regulation within the informal sector of Zambia shows how much the social setting of Zambia has influenced the kinds of policies that are implemented on food safety. With the informal sector accounting for 80% of the food market and consisting mainly of individuals and families, policies on how vendors are to conduct themselves are very broad and general. Zambia has instituted specific laws to address food safety (even though they do explicitly mention it in earlier laws on food). One of these laws is the Food and Drug Act, which was instituted in 1972 and was amended and consolidated with an earlier law in 2006 and 2019. This Act specifically addressed public health, adulteration, proper labeling, importation, etc. It was only in 2019 that it specifically mentioned and addressed food safety. This Act does not mention traceability but mentions proper labeling which alludes to a type of traceability. This shows Zambia's progress towards a safer food system.

Using Jasanoff's framework to understand regulatory bodies in Zambia shows how much this social setting has played a significant role in influencing policies that were implemented in that providing specific and stringent laws on how vendors within these settings are to conduct themselves would be difficult to implement.

US context. In the United States, there are a number of forces that have found their way in the policies that are used to regulate science and technology. Some of these forces include the fear of consuming unsafe foods and bioterrorism fears, as discussed in chapter one. These forces can largely be classified as social forces. Modern regulation attempts to address these fears, along with other risks, through the use of science and technology. One of these technologies is traceability. Thus, traceability functions not just as a technology to combat these fears and risks

but also a regulation tool. This can be seen in the introduction of the Farm Bill in 2002 (amended 2008) which in turn introduced country of origin labeling (COOL) to address consumer traceability concerns.

Earlier forces such as the publication of Upton Sinclair's *The Jungle* (1906) which brought to light the ill handling of meat in Chicago by the meat packing industry also helped push for food safety regulation and more scrutiny of the meat industry by the government. This book also helped push for laws that were already in formulation and were well on their way to implementation.

Later laws such as the Food Safety Modernization Act (FSMA), passed in 2011, were implemented to directly address traceability by giving the Food and Drug Administration (FDA) mandatory recall authority for all food types. FSMA also further showed the importance of using science and technology to prevent food borne illness, an increasing public health concern for the changing food system. The FDA notes how with the implementation of FSMA, some foodborne illnesses could be prevented. The amendment of the Federal Meat Inspection Act (FMIA) also helped in addressing the changing meat industry to prevent the sale of contaminated meat. Both the FSMA and FMIA allude to how foodborne illnesses can only be prevented through the use of science and technology. This study situated traceability as being a central tool in addressing food related risks and fears. It showed how traceability not only exposed these fears but also became a means of combatting them as seen in the case of food recalls and their increase in the last decade.

Formation of Food Safety Regulatory Bodies and Approaches to Risk

Risk culture in Zambian context. When it comes to issues of risk, Zambia defines risk in terms of finances. It also defines risk in terms of disease outbreak prevention (mainly cholera). This definition is broadly dependent on regulatory bodies like the Ministry of Local Government

and the Ministry of Health and authorities like the Zambian Army. This is seen in their implementation of policies that restrict and prohibit the sale of food by vendors at certain times of the year. When it comes to financial risk, Zambia's Zambef (as a leader in beef production) focuses exclusively on cash management strategies to combat foreign exchange and interest rate risks due to instability of the currency. This shows how even producers/manufacturers of beef have their own conceptions of what risks are important.

In the Zambian context, traceability is much more complex because of the different types of markets (formal and informal) and how they use it. In informal settings, traceability is used via word of mouth and is therefore not documented. In formal settings, traceability is documented. Laws like the Food and Drug Act stipulate how formal food businesses are to conduct themselves i.e., by properly handling food items and labelling them appropriately. Businesses like Zambef show where they source their products from—hinting at a supply-side management use for traceability. Since labeling is required, this also points to a traceability or safety use for labels. The Act itself states that labels are to be used to prevent safety hazards and to prevent misleading consumers about the value of the food product. This shows where Zambia's risk culture places emphasis—on financial and public health issues.

Mary Douglas and Aaron Wildavsky, as seen in chapter two, show how prioritization of risks is based on who is in power and level of social criticism of these risks. In the Zambian context, it is easier to observe how much power influences the prioritization of risks. As seen in chapter three, the military along with authorities like the Ministry of Health decide on which risks are important by enforcing policies to prevent certain risks over others. Specifically, these authorities implement policies to prevent spread of disease by prohibiting market vendors from

selling food during the rainy season when cholera outbreaks are more common. These risks are regulated for because they are a public health concern.

Risk culture in US context. For the United States, risk in food safety entails preventing food safety problems and also preventing economic risks. In the US context, traceability is intertwined with these risk perceptions as seen in the Food and Drug Administration (FDA)'s use of traceability for riskier foods. The FDA shows how fruits and vegetables are riskier and therefore warrant a proper traceability system. It does this by requiring additional traceability information through laws such as the Food Safety Modernization Act (FSMA).

As noted in chapter two, there have been several risks that traceability has addressed and brought to light. Some of these risks include food safety (recalls, etc.), health (vaccination histories of animals), economic, environmental concerns, and nutrition. Traceability has brought these risks to light by making it possible for consumers and producers to track and prove particular characteristics of beef. These particular risks have also been made known due to the particular risk culture of the US.

Drawing on what Douglas and Wildavsky point out, what drives these choices of risk prioritization is power and social criticism and the strength of this criticism. In a sense, what society prioritizes or are concerned about ends up becoming what is prioritized by regulators. This is seen where US consumers are now able to pinpoint certain attributes of beef production and these attributes have found their way in regulation of beef labeling.

The US and Zambia use traceability to combat perceived risks differently in some respects. For the US, traceability functions as a supply-side management tool to help food businesses manage financial risk. Zambia also uses traceability for supply-side management, but its use of traceability is not as pronounced as it is for the US. This is because traceability is

mandatory in the United States. Traceability also functions as a transparency or accountability tool for US consumers. In Zambia, traceability is seen through the requirements of labeling and through the use of word of mouth in informal settings.

The US and Zambia showed how definitions of risk and how to combat these risks differs in space and time and how tools like traceability were used to combat them. Approaches to mitigating risks vary amongst consumers, producers and regulatory bodies. In some instances, the use of traceability aligns with what regulators, producers and consumers intended to use it for.

In both countries, what influences risk cultures is trust in institutions, political leaders and in science and technology. For the Zambian public, trust is located in local political leaders, in individuals and in brands. For the US public, trust is located in information and knowledge of producers, which is found on labels. While the Zambian public generally trusts institutions, the US public due to its historical background in institutional failures does not trust in its institutions.

Information Infrastructure and Traceability Policies

Information infrastructures in food safety look differently within the social and political settings of Zambia and the US. In Zambia, information infrastructures are more apparent in formal settings than they are in informal ones. For example, the Zambian Food and Drug Act outlines how foods are to be labeled and how mislabeling is a punishable offence. Therefore, beef sold within formal settings must have appropriate labels.

Within informal settings, labeling is almost non-existent for beef products. Information here travels by word-of-mouth. These types of information infrastructures are more complex as there are a number of intermediaries through whom information travels. Due to the lack of documentation, this allows for information about product source to be lost in some instances.

This lack of documentation shows how infrastructures of information in the Zambian context are much more hidden than they are in the United States.

In the US, information infrastructures are more apparent through the use of labels and the type of information that is on the label such as the grade, harvest and processing method, etc. For any of this information to appear on a label, there should be a proper verification and or certification process. There should also be a proper traceability system in place. This exposes the entities involved in the labeling of beef, showing how hidden infrastructural processes are brought to light by traceability in the US context.

As discussed in chapter three, traceability has functioned as a convenient accountability technology in that it has served consumer demand for more information on beef products. In the US context, traceability has brought to light once hidden processes that are arguably still hidden within the Zambian food context such as processing information on the label. This is also seen in that Zambian consumers do not request additional information such as processing or lineage history of beef products while some US consumers do, showing how traceability not only brings to the fore issues of trust but also accountability within informational systems of certain countries.

Concluding Remarks

Using Wildavsky and Douglas' approach to risk culture, this study has shown how traceability as a technological device has seen a stronger social criticism in the US than it has in Zambia. Specifically, the US public has shown mistrust in science and in institutions and has therefore seen the need to establish systems that make such institutions credible in the eyes of consumers in the US. This is because the American public has associated or perceived more

dangers within their food system than have the Zambian public. These dangers have also seen traceability as a possible solution.

This study used Xaq Frohlich's approach to informational infrastructures to show how traceability has brought to light issues of trust and niches within the United States beef market. Traceability is relevant to consumers within certain markets, even though it is required in all market settings. The Zambian market showed how information about beef is more readily available within formal settings and how this information is regulated. In the US, technologies like traceability bring to the fore issues of trust by bringing to light infrastructures that would otherwise have remained hidden. Perhaps Zambian consumers would also be concerned about how their beef products were processed were it not for issues like affordability, availability and literacy.

Using Jasanoff comparative analytical approach as the overarching approach in this study helped show the ways in which politics and policy in science are informed by both private and public actors within the contexts of these two countries. Using this approach also helped show how countries situated in two different continents use the technology of traceability. For the case of Zambia, the cancellation of provisions and privatization of mines greatly influenced the type of markets that were born and how these markets are regulated. In the US, a number of social and political forces also influenced how food was regulated.

Future Traceability Studies

While Zambia is currently working on its food safety system, the US has had a longer history of food safety regulation and has therefore had time to improve on its system. The Zambian food safety system could improve on its approaches to safety within informal settings

by educating the public on the necessity of proper hygiene. Regulators can also empower vendors to practice hygiene at all times of the year and not just during the rainy season.

There seems to be different aspects or factors within the food regulatory spaces of the two nations that have influenced the modern food safety system. It would be beneficial for future studies to understand and focus on the role of traceability technologies, risk perceptions and food safety regulation as they inform current development and future approaches to food safety.

References

About the U.S. Department of Agriculture / USDA. (n.d.). Retrieved June 3, 2020, from

<https://www.usda.gov/our-agency/about-usda>

American Meat Association • FACT SHEET Anatomy of a Meat Product Label. (2015).

Retrieved from <https://meatscience.org/docs/default-source/publications-resources/fact-sheets/anatomy-of-a-meat-product-label-2016.pdf?sfvrsn=0>

Army steps in Zambia markets to stop cholera outbreak. (n.d.). Retrieved April 12, 2021, from

<https://www.aa.com.tr/en/africa/army-steps-in-zambia-markets-to-stop-cholera-outbreak/1019471>

Aung, M. M., & Chang, Y. S. (2014). Traceability in a food supply chain: Safety and quality perspectives. *Food Control*, 39, 172-184.

Background on the FDA Food Safety Modernization Act (FSMA) / FDA. (n.d.). Retrieved April

10, 2021, from <https://www.fda.gov/food/food-safety-modernization-act-fsma/background-fda-food-safety-modernization-act-fsma>

Becker, G. S. (2007). Animal identification and meat traceability. *Animal Agriculture Research Progress*, 91.

Caswell, J. A. (1998). How labeling of safety and process attributes affects markets for

food. *Agricultural and Resource Economics Review*, 27(1203-2016-94941), 151-158.

Certification. (n.d.). Retrieved June 8, 2020, from

<https://www.zabs.org.zm/departments/technical-services/certification.html>

CFR - Code of Federal Regulations Title 21. (n.d.). Retrieved April 10, 2021, from

<https://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfcfr/cfrsearch.cfm>

Check List for Mandatory Features on a Label | Food Safety and Inspection Service. (n.d.).

Retrieved April 5, 2021, from <https://www.fsis.usda.gov/guidelines/2013-0011>

Cooter, R., & Fulton, R. (2001). Food matters: food safety research in the UK public sector,

1917-1990. *Leatherhead Food Ra Food Industry Journal*, 4, 251-262.

CPG Sec 110.300 Registration of Food Facilities Under the Public Health Security and

Bioterrorism Preparedness and Response Act of 2002 | FDA. (n.d.). Retrieved November

18, 2020, from [https://www.fda.gov/regulatory-information/search-fda-guidance-](https://www.fda.gov/regulatory-information/search-fda-guidance-documents/cpg-sec-110300-registration-food-facilities-under-public-health-security-and-bioterrorism)

[documents/cpg-sec-110300-registration-food-facilities-under-public-health-security-and-](https://www.fda.gov/regulatory-information/search-fda-guidance-documents/cpg-sec-110300-registration-food-facilities-under-public-health-security-and-bioterrorism)

[bioterrorism](https://www.fda.gov/regulatory-information/search-fda-guidance-documents/cpg-sec-110300-registration-food-facilities-under-public-health-security-and-bioterrorism)

Crandall, P. G., O'Bryan, C. A., Babu, D., Jarvis, N., Davis, M. L., Buser, M., ... & Ricke, S. C.

(2013). Whole-chain traceability, is it possible to trace your hamburger to a particular steer, a US perspective. *Meat Science*, 95(2), 137-144.

Crush, J., & Frayne, B. (2011). Supermarket expansion and the informal food economy in

Southern African cities: implications for urban food security. *Journal of Southern African*

Studies, 37(4), 781-807.

- Di Pierro, M. (2017). What is the blockchain? *Computing in Science & Engineering*, 19(5), 92-95.
- Douglas, M., & Wildavsky, A. (1983). *Risk and culture: An essay on the selection of technological and environmental dangers*. Univ of California Press.
- Felia, B., & Chilufya, W. (n.d.). *TAKING STOCK: ZAMBIA FOOD CHANGE LAB*.
https://www.sustainablediets4all.org/assets/2018/08/Zambia-Food-Change-Lab_online.pdf.
- Federal Meat Inspection Act*. (n.d.). Retrieved May 25, 2020, from
[https://www.agriculture.senate.gov/imo/media/doc/Federal Meat Inspection Act.pdf](https://www.agriculture.senate.gov/imo/media/doc/Federal%20Meat%20Inspection%20Act.pdf)
- Food and Drugs Act, Cap 303 | Zambia Legal Information Institute*. (n.d.). Retrieved May 21, 2020, from <https://zambialii.org/node/8026>
- Frohlich, X. (2016, May 13). *Food and Power: Introduction, pt. 1*. YouTube.
<https://www.youtube.com/watch?v=zwrNMLgTFZg>.
- Food Safety Act, 2019, 2019 | Zambia Legal Information Institute*. (n.d.). Retrieved April 1, 2021, from <https://zambialii.org/node/14101>
- Food Safety Modernization Act (FSMA) | FDA*. (n.d.). Retrieved April 1, 2021, from
<https://www.fda.gov/food/guidance-regulation-food-and-dietary-supplements/food-safety-modernization-act-fsma>
- Food Safety and Inspection Service*. Recalls & Public Health Alerts | Food Safety and Inspection Service. (n.d.). <https://www.fsis.usda.gov/recalls>.

Fraser, E., Moonga, M., & Wilkes, J. (2014). *The role of the informal economy in addressing urban food security in sub-Saharan Africa*. CIGI.

Frohlich, X. (2017). The informational turn in food politics: The US FDA's nutrition label as information infrastructure. *Social Studies of Science*, 47(2), 145–171.
<https://doi.org/10.1177/0306312716671223>

FSMA Final Rule for Preventive Controls for Human Food | FDA. (n.d.). Retrieved April 10, 2021, from <https://www.fda.gov/food/food-safety-modernization-act-fsma/fsma-final-rule-preventive-controls-human-food>

Fuseini, I., Battersby, J., & Jain, N. (2018). 14 The characteristics of the urban food system in Kitwe, Zambia. *Urban Food Systems Governance and Poverty in African Cities*, 195.

Golan, E. H., Krissoff, B., Kuchler, F., Calvin, L., Nelson, K. E., & Price, G. K. (2004). *Traceability in the US food supply: economic theory and industry studies* (No. 1473-2016-120760).

Grace, D. (2015). Food safety in developing countries: an overview.

Hakobyan, A. (n.d.). *Food Safety in Zambia: How Small Improvements Can Have Big Impact*. World Bank Blogs. <https://blogs.worldbank.org/voices/food-safety-zambia-how-small-improvements-can-have-big-impact>.

Harnessing the potential of Zambia's informal food sector | International Institute for Environment and Development. (n.d.). Retrieved August 28, 2020, from

<https://www.iied.org/harnessing-potential-zambias-informal-food-sector>

Harris, J., Chisanga, B., Drimie, S., & Kennedy, G. (2019). Nutrition transition in Zambia: Changing food supply, food prices, household consumption, diet and nutrition outcomes. *Food Security, 11*(2), 371-387.

Hazard Analysis Critical Control Point (HACCP) | FDA. (n.d.). Retrieved June 8, 2020, from

<https://www.fda.gov/food/guidance-regulation-food-and-dietary-supplements/hazard-analysis-critical-control-point-haccp>

Informal food markets in Zambia. (n.d.). Retrieved August 28, 2020, from

<https://pubs.iied.org/pdfs/16659IIED.pdf>

Institute of Medicine (US) Food and Nutrition Board. (1990, January 1). *INTRODUCTION AND*

HISTORICAL REVIEW OF MEAT INSPECTION. Cattle Inspection: Committee on Evaluation of USDA Streamlined Inspection System for Cattle (SIS-C).

<https://www.ncbi.nlm.nih.gov/books/NBK235649/>.

Jasanoff, S. (2005). *Designs on nature: Science and democracy in Europe and the United States*.

Princeton University press.

Kanduza, A. M. (1991). History and Agricultural Change in Zambia. *Transafrican Journal of*

History, 97-109.

Kianoosh Hashemzadeh | July 19, 2019. (2019, July 25). *Distrust of Science Is as American as Apple Pie: The Takeaway*. Zócalo Public Square.

<https://www.zocalopublicsquare.org/2019/07/19/distrust-of-science-is-as-american-as-apple-pie/events/the-takeaway/>.

Lang, J. T. (2013). Elements of public trust in the American food system: Experts, organizations, and genetically modified food. *Food Policy*, 41, 145-154.

Levenstein, H. A. (2012). *Fear of food: a history of why we worry about what we eat*. The University of Chicago Press.

Legal Information Institute. (n.d.). *21 CFR Part 10 - ADMINISTRATIVE PRACTICES AND PROCEDURES*. Legal Information Institute. <https://www.law.cornell.edu/cfr/text/21/part-10>.

Low, S. A., Adalja, A., Beaulieu, E., Key, N., Martinez, S., Melton, A., Perez, A., Ralston, K., Stewart, H., Suttles, S., Vogel, S., & Jablonski, B. B. (2015). *United States Department of Agriculture Trends in U.S. Local and Regional Food Systems*. www.ers.usda.gov/publications/ap-administrative-publication/ap-068

Lynn, F. M., & Hadden, S. G. (1988). Risk and information read the label: Reducing risk by providing information. *Journal of Policy Analysis and Management*, 7(3), 584.

<https://doi.org/10.2307/3323742>

- Makinen, G. (2002, August). Report for Congress: The Economic Effects of 9/11: A Retrospective Assessment. Congressional Research Service. In The Library of Congress, online at <http://www.fas.org/irp/crs/RL31617.pdf>. Accessed (Vol. 30).
- Martinez, M. G., Fearne, A., Caswell, J. A., & Henson, S. (2007). Co-regulation as a possible model for food safety governance: Opportunities for public-private partnerships. *Food Policy*, 32(3), 299-314.
- Milestones in U.S. Food Law — Food Law*. (n.d.). Retrieved June 1, 2020, from <https://www.ag.ndsu.edu/foodlaw/overview/history/milestones>
- Ministry Of Fisheries and Livestock » Food safety and toxicological examinations and monitoring*. (n.d.). Retrieved June 3, 2020, from https://www.mfl.gov.zm/?page_id=4933
- Ministry of Agriculture » Who we are*. (n.d.). Retrieved June 3, 2020, from https://www.agriculture.gov.zm/?page_id=4806
- Ministry of Health » About Ministry*. (n.d.). Retrieved June 3, 2020, from https://www.moh.gov.zm/?page_id=5820#1544791959507-17939e13-99a6
- Mirabelli, G., Pizzuti, T., Gómez González, F., & Sanz Bobi, M. Á. (n.d.). *Food traceability models: an overview of the state of the art*. Handle Proxy.<http://hdl.handle.net/11531/5518>.
- Mwango, M., Kaliba, M., Chirwa, M., Guarín Alejandro, & International Institute for Environment and Development. (2019). *Informal food markets in Zambia: perspectives from vendors, consumers and policymakers in Lusaka and Kitwe* (Ser. Discussion paper).

International Institute for Environment and Development (IIED).

<https://pubs.iied.org/16659IIED/>.

Nakazwe, M. (1998). *Food legislation in Third World Countries: A case Study of Zambia* (Doctoral dissertation, University of Natal)

Nyarugwe, S. P., Linnemann, A. R., Fogliano, V., Luning, P. A., Ren, Y., Bakker, E.-J.,

Watson, D., Fogliano, V., & Luning, P. A. (2020). An intercontinental analysis of food safety culture in view of food safety governance and national values. *Food Control, 111*.

<https://doi.org/10.1016/j.foodcont.2019.107075>

Nguyen, H. V., Nguyen, N., Nguyen, B. K., Lobo, A., & Vu, P. A. (2019). Organic food purchases in an emerging market: The influence of consumers' personal factors and green marketing practices of food stores. *International Journal of Environmental Research and Public Health, 16*(6), 1037.

Organic Beef | Agricultural Marketing Resource Center. (n.d.). Retrieved March 2, 2021, from

<https://www.agmrc.org/commodities-products/livestock/beef/organic-beef>

Preparedness, B. (2002). Public health security and bioterrorism preparedness and response act of 2002. *Public Law, 107*(188), 188.

Pure Food Act. (n.d.). Retrieved May 25, 2020, from http://library.clerk.house.gov/reference-files/PPL_059_384_FoodDrugCosmeticAct.pdf

Public Health Act (Cap.295). (n.d.). Retrieved August 18, 2020, from

<https://www.ecolex.org/details/legislation/public-health-act-cap295-lex-faoc092748/>

Reductionism / Health Topics / NutritionFacts.org. (n.d.). Retrieved April 5, 2021, from <https://nutritionfacts.org/topics/reductionism/>

Reijers, W., O'Brolcháin, F., & Haynes, P. (2016). Governance in blockchain technologies & social contract theories. *Ledger, 1*, 134-151.

Röhr, A., Lüddecke, K., Drusch, S., Müller, M. J., & Alvensleben, R. V. (2005). Food quality and safety—consumer perception and public health concern. *Food Control, 16*(8), 649-655.

Schwägele, F. (2005). Traceability from a European perspective. *Meat Science, 71*(1), 164-173.

Seshamani, V. (1998). The impact of market liberalisation on food security in Zambia. *Food Policy, 23*(6), 539–551. [https://doi.org/10.1016/S0306-9192\(98\)00061-X](https://doi.org/10.1016/S0306-9192(98)00061-X)

Sichilima, T., Mapemba, L., & Tembo, G. (2010). What determines expenditure allocation to beef among Lusaka residents in Zambia? Evidence from household survey. *Modern Economy, 6*(03), 411-422.

Sililo, N. (2017). *From Agriculture to Technology: Science Policy in Zambia Since Independence* (Doctoral dissertation, Stellenbosch: Stellenbosch University)

Sinyange, N., Brunkard, J. M., Kapata, N., Mazaba, M. L., Musonda, K. G., Hamoonga, R., ... & Mukonka, V. M. (2018). Cholera Epidemic—Lusaka, Zambia, October 2017–May 2018. *Morbidity and Mortality Weekly Report, 67*(19), 556.

Smith, G. C., Pendell, D. L., Tatum, J. D., Belk, K. E., & Sofos, J. N. (2008). Post-slaughter traceability. *Meat Science, 80*(1), 66-74.

Swab, J. C. (1993). Food and health: the Zambian experience. *Africa Today, 40*(3), 55-68.

The Food Safety Bill, 2019 / National Assembly of Zambia. (n.d.). Retrieved June 9, 2020, from <http://www.parliament.gov.zm/node/7976>

The Laws of Zambia Copyright Ministry of Legal Affairs, Government of the Republic of Zambia
REPUBLIC OF ZAMBIA THE FOOD AND DRUGS ACT CHAPTER 303 OF THE LAWS
OF ZAMBIA CHAPTER 303 THE FOOD AND DRUGS ACT THE FOOD AND DRUGS
ACT ARRANGEMENT OF SECTIONS PART. (n.d.). Retrieved from <https://www.parliament.gov.zm/sites/default/files/documents/acts/Food%20and%20Drugs%20Act>

The Laws of Zambia Copyright Ministry of Legal Affairs, Government of the Republic of Zambia
REPUBLIC OF ZAMBIA THE BRANDS ACT CHAPTER 244 OF THE LAWS OF ZAMBIA
CHAPTER 244 THE BRANDS ACT THE BRANDS ACT ARRANGEMENT OF SECTIONS
Section. (n.d.). Retrieved from <http://extwprlegs1.fao.org/docs/pdf/zam47265>

The Potential of Blockchain Technology Application in the Food System - IFT.org. (n.d.). Retrieved April 3, 2021, from <https://www.ift.org/career-development/learn-about-food-science/food-facts/food-facts-emerging-science-and-technologies/the-potential-of-blockchain-technology-application>

The public health (meat, abattoir and butcheries) regulations [arrangement of regulations]. (n.d.). Retrieved August 18, 2020, from <http://extwprlegs1.fao.org/docs/pdf/zam92811.pdf>

Thomas, C. I. P. (2010). *The Problem with Purity: Market Failures, Foodborne Contamination, and the Search for Accountability in the US Food Safety Regulatory Regime* (Doctoral dissertation, Virginia Tech).

Tian, F. (2017, July 28). A supply chain traceability system for food safety based on HACCP, blockchain & Internet of things. *14th International Conference on Services Systems and Services Management, ICSSSM 2017 - Proceedings*.

<https://doi.org/10.1109/ICSSSM.2017.7996119>

Traceability & Recalls | Food safety and quality | Food and Agriculture Organization of the United Nations. (n.d.). Retrieved April 2, 2021, from <http://www.fao.org/food-safety/food-control-systems/supply-chains-and-consumers/traceability-and-recalls/en/>

“Traceability’ / ‘Product Tracing’ in Codex.” *Fao.org*, www.fao.org/waicent/faoinfo/food-safety-quality/cd_hygiene/cnt/cnt_en/sec_3/docs_3.6/Traceability.pdf.

Umberger, W. J., Boxall, P. C., & Lacy, R. C. (2009). Role of credence and health information in determining US consumers’ willingness-to-pay for grass-finished beef. *Australian Journal of Agricultural and Resource Economics*, 53(4), 603-623.

U.S. Food and Drug Administration. FDA Regulatory Procedures Manual Chapter 7: RECALL PROCEDURES. (n.d.). <https://www.fda.gov/media/71814>.

USDA FARMERS MARKET 2019 Rules and Procedures and Operating Guidelines. (n.d.). Retrieved March 29, 2021, from www.usdalocalfooddirectories.com.

U.S. Beef Grading - YouTube. (n.d.). Retrieved April 3, 2021, from <https://www.youtube.com/watch?v=tEHwm1gIj-w>

[USC02] 21 USC Ch. 12: MEAT INSPECTION. (n.d.). Retrieved June 1, 2020, from <https://uscode.house.gov/view.xhtml?path=/prelim@title21/chapter12&edition=prelim>

Vázquez, J. F., Pérez, T., Urena, F., Gudin, E., Albornoz, J., & Domínguez, A. (2004). Practical application of DNA fingerprinting to trace beef. *Journal of Food Protection*, 67(5), 972-979.

What We Do / FDA. (n.d.). Retrieved June 3, 2020, from <https://www.fda.gov/about-fda/what-we-do>

Zach, L. (2016). Legal Requirements and Regulation for Food Traceability in the United States. In *Advances in Food Traceability Techniques and Technologies: Improving Quality Throughout the Food Chain* (pp. 237–260). Elsevier Inc. <https://doi.org/10.1016/B978-0-08-100310-7.00013-2>

Zambian Parliament. (n.d.). *THE PUBLIC HEALTH ACT*. Retrieved May 26, 2020, from <http://www.parliament.gov.zm/sites/default/files/documents/acts/Public Health Act.pdf>