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Zoonosis and the law: a case study of legal game meat regulation and control in Zambia

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Globally, game meat production is increasing. Yet, in many countries, game meat supply chains are not formally regulated and traceability issues have also been raised. As a consequence, there is an increased risk of zoonotic disease outbreaks. Thus, there is a growing call for a greater role of law and policy (environmental justice) in game animal and game meat products to secure animal and human health. Zambia is one of the countries where game meat production is increasing and legally traded. There is a paucity of information on Zambian laws, regulations, and policies governing the game meat trade. To understand this phenomenon in light of environmental justice concerns, we conducted a case study analyzing the Zambian regulatory framework and policies related to the game meat supply chain. The study included a review of Zambian laws and policies that address the game meat chain, focused on game meat zoonosis risks, and interviews with stakeholders in the game meat supply chain. This was followed by a zoonoses vulnerability assessment of the chain prompted by the absence of specific game meat regulations. The policy analysis revealed a lack of specific regulations governing game meat safety, with limited control over game meat along the supply chain. Several gaps in the law and policy frameworks were identified. To enhance game meat safety and reduce zoonotic disease transmission along the game meat supply chain, the use of a zoonotic control framework is recommended. We conclude with a discussion of the international implications of this Zambian use case.

KEYWORDS

environmental justice, food safety, policy, risk analysis, regulations

1 Introduction

1.1 Environmental justice

The sustainability of natural resources is a key principle of environmental justice. According to [Matsumoto \(2023\)](#), environmental justice “mandates the right to ethical, balanced and responsible uses of land and renewable resources in the interest of a sustainable planet for humans and other living things ... Affirms the right of all workers

to a safe and healthy work environment...” Game meat is meat from wild animals that are typically hunted for food. Legal game meat production is a multifaceted environmental justice issue. For example, regulations regarding legal game meat production place controls on hunting in national parks (NPs), community partnership parks, and bird and wildlife sanctuaries. This helps to protect these habitats from disturbances and degradation, ensuring that ecosystems remain intact and healthy. It provides alternatives to illegal game meat trade through game farming (Tensen, 2016; Wang et al., 2019), which can lead to a decline in the illicit game meat trade (Murray et al., 2016; Fukushima et al., 2021). By doing so, it prevents environmental injustices associated with the illicit trade, which impacts both animals and people. White and Belant (2015) highlighted that game meat production not only provides game meat as a communal benefit but also contributes revenue to communities through hunting fees and licenses. This sustains marginalized communities where hunting typically occurs. Game farming through community conservancies also benefits the communities through income generation. This is important because these communities struggle to farm or raise livestock due to wildlife interference (Pant et al., 2025). There are also ecological benefits associated with game farming (Pienaar et al., 2017), such as counterbalancing the impacts of wild animals due to overhunting (Lindsey et al., 2009).

To ensure social and ecological justice in the game meat supply chain, it is imperative to understand the stakeholders, operations, regulations, and regulatory constraints (FAO, 2011). Such knowledge enables the development of an effective regulatory framework, thereby protecting habitats, wild species, and people. Therefore, we analyzed Zambian game meat regulations and policies and conducted in-depth stakeholder interviews. Based on our findings, we propose a zoonotic control framework that can be used to enhance game meat safety and reduce zoonotic disease transmission from wildlife to humans along the game meat supply chain. Our paper concludes with a discussion of the international implications of this Zambian use case.

1.2 Game meat production

Humans have always engaged in game hunting in Africa as a life necessity (Muposhi et al., 2016). Until the 20th century, game hunting proceeded according to tribal customs. However, when European settlers became established on the continent and started overharvesting native wildlife, the need arose to introduce conservation laws (Munro, 2021). The emergent regulations delineated legal and illegal game meat. In theory, these regulations resolved the environmental (species) injustices brought on by the overexploitation of game species, fostering the sustainable use of this natural resource. Since then, game meat production (UNECE and FAO, 2018) and marketing (Green et al., 2023) have been rising; not only in Africa but also globally. Although there is a dearth of available data, the global production of game meat is estimated to have reached approximately 2 million tons in 2016 (Rawal et al., 2019), with Africa and Europe being the

highest producers. The United Nations Economic Commission for Europe (UNECE) region almost doubled its export value in the space of a decade, from US\$190 million in 2001 to US\$365 million in 2011 (UNECE and FAO, 2018). In 2013, UNECE reached a production of 400,000 tons of game meat valued at approximately \$850 million (Rawal et al., 2019). South Africa is the largest exporter in the Southern African Development Community (SADC) region, exporting approximately 3,010 tons of game meat per year (Department of Forestry, Fisheries and the Environment, South Africa, 2023). Namibia is another major SADC game meat producer, with an annual output of approximately 17,637–28,660 tons.

Ranucci and colleagues (Ranucci et al., 2021) highlighted that game meat production differs significantly from that of domestic meats, as factors present in the field and the steps taken before transferring carcasses to a game-handling establishment affect game meat and handler safety. These factors, including poor hygiene, handling practices, and occupational exposure, increase zoonotic risks to the consumer (Paige et al., 2014; D’Cruze et al., 2020) and the hunter/processor. The risk of contracting zoonoses is largely due to human exposure to body fluids and feces of game animals during handling and butchering. Considering that zoonotic risk exposure results from a contaminated environment or inadequate biosecurity measures, zoonotic risk needs to be viewed through social justice and environmental justice lenses.

According to the World Health Organization (WHO, 2020), zoonotic diseases are any diseases or infections that are naturally transmissible from vertebrate animals to humans. It has been reported that 60.3% of emerging human infectious diseases are animal-borne, of which 71.8% have originated from wildlife (Chai et al., 2023). These diseases are considered a social justice issue because people from lower socioeconomic backgrounds are often disproportionately affected due to factors such as limited access to healthcare, poor sanitation, close contact with animals due to livelihood needs, and inadequate knowledge about disease prevention, leading to higher exposure and vulnerability to zoonotic diseases. This highlights inequalities in health outcomes across different communities (van Der Westhuizen et al., 2023).

Recently, game meat regulation, control, and policy have gained attention as a result of zoonotic disease outbreaks (van Vliet et al., 2022; Wegner et al., 2022; Gallo-Cajiao et al., 2023). Examples include severe acute respiratory syndrome (SARS) in China (Can et al., 2019), Ebola in West Africa (Bonwitt et al., 2018), and mpox in the Democratic Republic of Congo (Lâm et al., 2024). In addition, concerns have been raised that food safety regulations are failing to prevent hazards in the food chain and that food safety standards do not apply to game meat (OECD, 2021). Still, as a matter of policy, efforts have been made to ban both legal and illegal game meat as a public health protection strategy (Eskew and Carlson, 2020). Banning the game meat trade could constitute an environmental injustice since indigenous and marginalized people are the ones who largely benefit from this resource as a necessity (Green, 2025). Booth and colleagues (Booth et al., 2021) pointed out that there is no justice in banning the game meat trade because it would adversely impact the people reliant on game meat for their lives

and livelihoods. Instead, they suggest risk-based regulation. To develop and implement risk-based regulatory frameworks, there is a need to understand the existing regulatory structures and perform a vulnerability assessment of both the public and the product to determine where risk mitigation can be achieved.

Because game farms can provide a higher degree of sanitary conditions (Broad, 2020), farmed game meat has been shown to carry less zoonosis risk than wild game (Magwedere et al., 2015; OECD, 2021). Farmed game is confined to farms, where the animals are protected from predation, and more importantly, disease control measures can be applied to them. In contrast, free-ranging game are prone to predation, and disease control measures are difficult to apply (Magwedere et al., 2015; OECD, 2021). The importance of biosecurity (preventing harm by biological agents) as a measure of controlling zoonotic diseases in game and game products has been recognized by the WHO, World Organization of Animal Health (WOAH), and the Food and Agricultural Organization of the United Nations (FAO). Their interim guidance emphasizes that the regulations should include strict on-farm biosecurity measures to prevent the introduction and/or spread of zoonotic diseases (WHO, WOAH, UNEP, 2021).

The farming of game animals for game meat is a common practice in many parts of the world (Needham et al., 2023). However, despite increased game meat production in many countries, particularly developing nations, the game meat supply chain is still not formally regulated due to a lack of legal instruments (WHO, WOAH, UNEP, 2021). Game meat traceability concerns have been raised for the product supply chain (Campbell et al., 2022). The biggest regulatory and traceability challenges are in Asia and Africa (World Bank, FAO, 2022a), as countries in these regions have a large informal food sector that is not regulated and does not adhere to central government legislation on hygiene (Oloo et al., 2018). In many countries, the major animal-based food laws, such as the Animal Health Acts, Meat Industry Acts, and Food Safety Acts, that regulate the domestic meat supply chain do not cover game meat chains. Game and game meat should have specific hygiene regulations requirements for its production, processing, and marketing in all national food regulations (WHO, WOAH, FAO, 2021).

1.3 The Zambian situation

Zambia has an abundance of natural resources and a rich biodiversity. The majority of Zambians, particularly those residing in rural areas, are highly dependent on the ecological services for their livelihoods (FAO, 2013). The network of Zambia's statutory protected areas (PA) is composed of over 63,580 km² in 20 NPs, about 167,557 km² in 36 Game Management Areas (GMAs), 5,981 km² game ranches, and 74,361 km² in 490 Forest Reserves (United Nations Convention on Biological Diversity, 2015). For this case study, understanding mammal diversity in Zambia is particularly important. Researchers estimate the country hosts 224 mammal species. Of these, 43 large mammals are vital to the country's

economy due to the potential income that can be produced from their use in photographic and consumptive tourism, and the protein they contribute to local households through game meat hunting (United Nations Convention on Biological Diversity, 2015). In 2023, as part of National One Health Strategic Plan 2022–2026, Zambia produced a list of zoonotic priority diseases, including African trypanosomiasis, anthrax, enteric diseases (salmonellosis), viral hemorrhagic fevers (Ebola), rabies, plague, influenza-like illnesses (zoonotic avian influenza), zoonotic tuberculosis, cysticercosis, and brucellosis (WHO, 2023). Of these, anthrax (Hang'ombe et al., 2012), salmonellosis (Altissimi et al., 2024), zoonotic tuberculosis (van der Merwe and Michel, 2010), and viral hemorrhagic fevers (Altissimi et al., 2024) have been associated with game meat.

We selected Zambia for our investigation of regulatory structures as a step toward risk-based regulatory framework development because it is one of the few countries in Africa that has a formalized game meat system (FAO et al., 2024). In Zambia, legal game meat comes from GMAs (Phiri et al., 2011) and game ranches (Lindsey et al., 2013). GMAs are considered buffer zones immediately surrounding national parks, where human settlement, limited agricultural activity, and legal game hunting are allowed (Phiri et al., 2011). Ranches produce an estimated 295,000 kg (325 tons) of game meat each year, with 37.2% coming from trophy hunting. Most of the game meat is sold to butcher shops or individual customers (48.8%), followed by ranch workers (20.7%), ranch guests/families, (12.2%), and local communities (12.2%) (Lindsey et al., 2013). In Zambia, legal game is categorized into wild game meat and farmed game meat depending on the source. Wild game meat is the meat that is found in either controlled or wild populations (national parks or reserves), while farmed game is intentionally reared to produce meat and hides (Whyte et al., 2011).

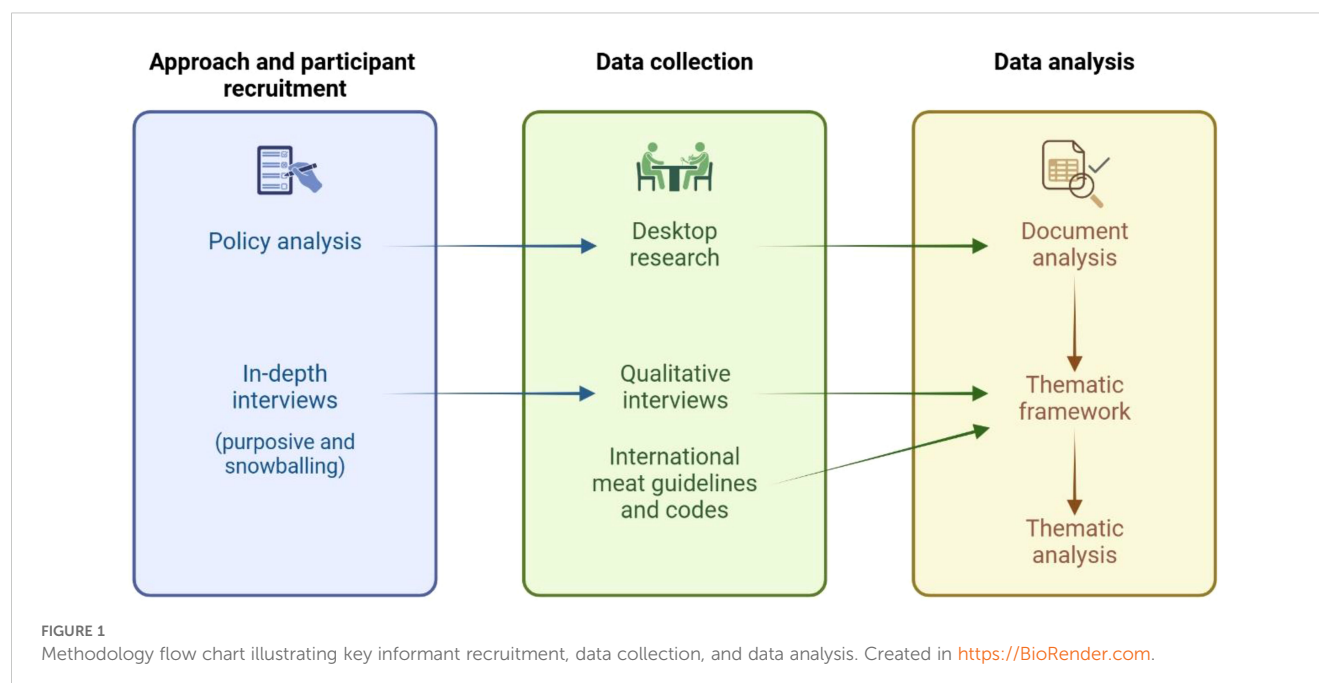
2 Methodology

2.1 Study area

The study was undertaken in the Lusaka district, one of the six districts of Lusaka province and the capital city of Zambia. Most of the legal game meat is traded in this area. It has an estimated population of approximately 3 million (Zambia Statistics Agency, 2023). Lusaka is located at -15.41 latitude and 28.29 longitude and is situated at an elevation of 1,277 meters above sea level (as obtained by Google Earth).

2.2 Approach and design

This cross-sectional qualitative study (Figure 1) was conducted in two parts (policy analysis and interviews) to answer the following research questions: Does the country have specific game meat regulations? What stages of the supply chain are covered? Which laws and agencies are responsible? What mandates do they have?



Does the law cover the marketing of products? Do the laws cover zoonotic diseases? What control mechanisms are in place? Are there adequate monitoring and enforcement powers?

The policy analysis focused on a literature search of regulations and policies associated with game, livestock, and the meat industry to address the following questions: Are there specific game meat regulations? Do they cover game safety and zoonosis?

The in-depth interviews focused on answering the following questions: If the regulations cover game meat, what are the implementing mechanisms? Are there adequate monitoring and enforcement powers? If they do not cover game meat, then how is the game meat being controlled?

2.3 Policy analysis

2.3.1 Data collection

The literature search was conducted from February 2024 to March 2024. In many countries, meat regulations, both for domestic livestock meat and game meat, are in a single document [(EC) No 853/2004; CAC/RCP 58-2005]. Hence, policy analysis focused on relevant policies and regulations of the meat industry for domestic livestock meat and game meat. This is particularly important since the creation of game meat regulations is guided by domestic livestock meat regulations.

Relevant documents are not limited to scholarly databases. Therefore, the Google search engine was used to gather information on acts, regulations, and policies that are relevant to the game meat industry. These documents were searched using the keywords *game meat regulation*, *animal regulations*, *wildlife regulations*, *conservation acts*, *animal health*, *disease act*, *meat regulations*, *meat act*, *meat standards*, *food safety act*, *food standards*, and *livestock policy* in combination with the term

Zambia. The following relevant documents were identified in response: The Wildlife Act of 2015, the Animal Health Act of 2010, the Public Health Act (Meat, Abattoir, and Butcherries Regulations), the Food Safety Act of 2019, and the National Livestock Development Policy of 2020. The list was sent to two Zambian food safety experts with experience in both food safety consultancy and academia for validation and to identify any relevant gaps.

2.3.2 Data analysis

Document analysis is a systematic procedure for reviewing or evaluating documents, both printed and electronic (Bowen, 2009). Following standard guidance (WHO, WOA and FAO, 2021), the analysis was based on the presence or absence of key terms (i.e., *game meat*, *game*, *wild game*, *wild meat*, *zoonosis*, *animal*, *trade/selling*) and several aspects of game meat production (i.e., farm biosecurity; specific hygienic requirements for the production, processing, and marketing of foods of animal origin; ante- and post-mortem inspection; hygiene and sanitation requirements, traceability requirements; farm registration; inspections; and supervision of the slaughtering process).

2.4 In-depth interviews

The interviews followed the human subjects research requirements. Ethical clearance was obtained from the Tropical Disease Research Centre (TDRC/124/09/23). Research permits were obtained from government agencies and departments. Consent was obtained from the interviewees prior to conducting the interviews. In-depth interviews and structured questionnaires were conducted from March 2024 to April 2024. These in-depth interviews provided the contextual data necessary to fully understand how exactly the

game meat is being controlled and regulated along the supply chain, which would not have been possible to capture by only using questionnaires.

2.4.1 Participant selection

A purposive sampling method was used (Palinkas et al., 2015). In total, 17 in-depth interviews were conducted with chief inspectors, directors, national focal officers, academicians, consultants, senior specialists from regulatory agencies, inspectorates, and butchers/traders. The interview guide is provided in the Supplementary Material. Of the 17 interviews, six were personnel from government institutions that are responsible for regulation and control, and the other 11 were experts in food safety and the game meat industry. Since data collection and analysis were conducted concurrently as the benchmark for grounded theory, each interview was deemed complete when new information was no longer being conveyed.

2.4.2 Data collection and transcription

For data collection and transcription, we followed an approach used by Goodall (2022). Interviews ranged between 25 minutes to 1 hour and 40 minutes and took place in offices, over phone calls, Microsoft Teams, Zoom, and Google Meet. In-person interviews were recorded using a recording device. Since an in-depth interview approach was used, some individuals were inclined to share more than others. We refrained from interrupting interviewees so that the maximum data could be collected. Variation in the electronic

platform use approach was for the convenience of the interviewees as access to standardized platforms can be limited in Zambia. Standardizing platform use would have hindered data capture.

Phone interviews were recorded on the phone. Zoom/Microsoft Teams and Google Meet interviews were recorded on the computer. In all these interviews, consent was sought first. In-person and phone-recorded interviews were transferred to a computer for transcription. Artificial intelligence (AI) Whisper, a function embedded in the Python software, was used for data transcription. Recorded audio files were input into the application, and Microsoft text transcripts were generated. Interviews were transcribed in English and the outputs were uploaded to NVivo 12 for coding and data analysis.

2.5 Data analysis

2.5.1 Thematic framework

The transcripts were analyzed in two parts. Firstly, a general understanding was sought of the regulatory control mechanisms for game meat. This understanding combined with, the *Codex, Code of Hygienic Practice for Meat (CAC/RCP 58-2005)*, *Technical Guidance Principles of Risk-Based Meat Inspection and Their Application (FAO, 2021)* and standard guidelines (WHO, WOA, UNEP, 2021) were then used to formulate a zoonotic control framework as presented in Figure 2. The framework is made up of three

ZOONOTIC DISEASE CONTROL IN THE GAME MEAT SUPPLY CHAIN

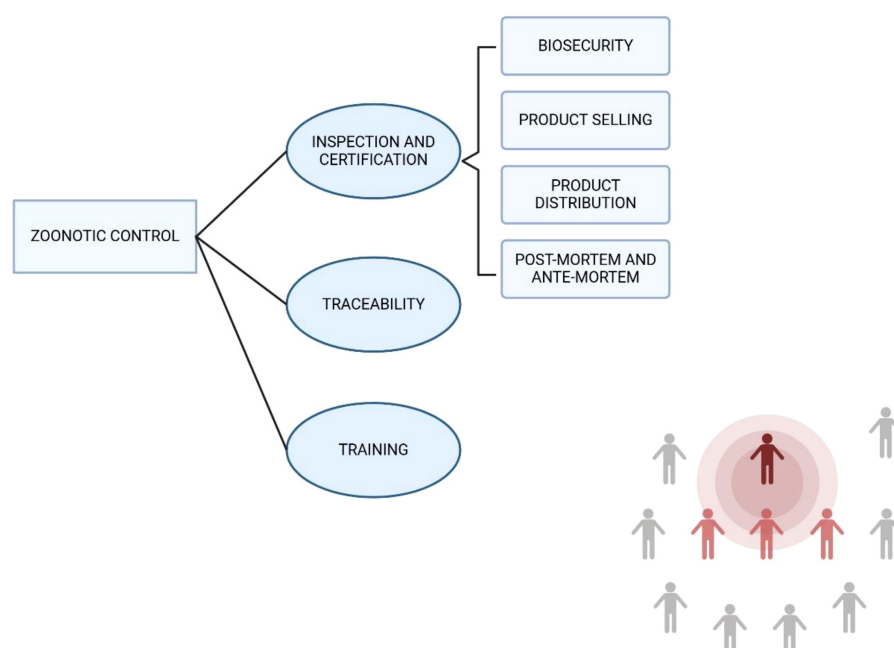


FIGURE 2

The thematic framework used to understand points of zoonotic disease control along the game meat supply chain. Created in <https://BioRender.com>.

components: inspections (which are subdivided into four elements: biosecurity, post-mortem and ante-mortem, product distribution and selling), traceability, and training. This zoonotic control framework can be used to understand points of zoonotic disease control along the game meat supply chain. The thematic framework was used for thematic coding (data analysis). For the second aspect of the data analysis, inspection, selling, traceability, and training were used as coding themes.

2.5.2 Thematic analysis

For part two of the data analysis, grounded theory was used for coding as previously conducted by Goodall (2022) and Milstein et al. (2020). This approach is used when little is known regarding the phenomena being studied (Glaser and Strauss, 2017; Chun Tie et al., 2019). For initial coding, transcribed data was broken and categorized into themes followed by theoretical coding, which wove the broken data back together into an organized theory (Charmaz, 2012). Finally, advanced coding was used to facilitate the integration of the final theory (Chun Tie et al., 2019).

3 Results

A summary of the meat (domestic and game) regulations and guidelines identified during the desktop study, along with the responsible authorities, is shown in Figure 3.

3.1 Policy analysis

Five Zambian laws were identified that are relevant to game meat, each with varying environmental justice implications. The Wildlife Act of 2015 relates to the sustainability of natural resources. The Animal Health Act of 2010 and the National Livestock Development Policy of 2020 cover equity in health prioritization between domestic and game animals. The Animal Health Act of 2010, the Public Health Act (Meat, Abattoir, and Butcheries Regulations), and the Food Safety Act of 2019 protect consumer safety.

3.1.1 Zambia Wildlife Act of 2015

The Zambia Wildlife Act of 2015 is the primary regulation establishing conditions for the game meat trade, both farmed and wild, in Zambia. The Department of National Parks and Wildlife (DNPW) under the Ministry of Tourism and Arts (Figure 3) is responsible for executing its responsibilities. The Act defines animals as all wild species. Game meat is defined under the topic of trophies together with other game products such as horns, tusks, and skins. The Act empowers the Minister, on the advice of the Director, to regulate the trade or movement of meat, game, or protected wildlife. In addition, the Act criminalizes the hunting of game animals for game meat without a license and possession to sell and the purchase of game animals or meat without certification. Furthermore, the Act accords an authorized officer to apply or order

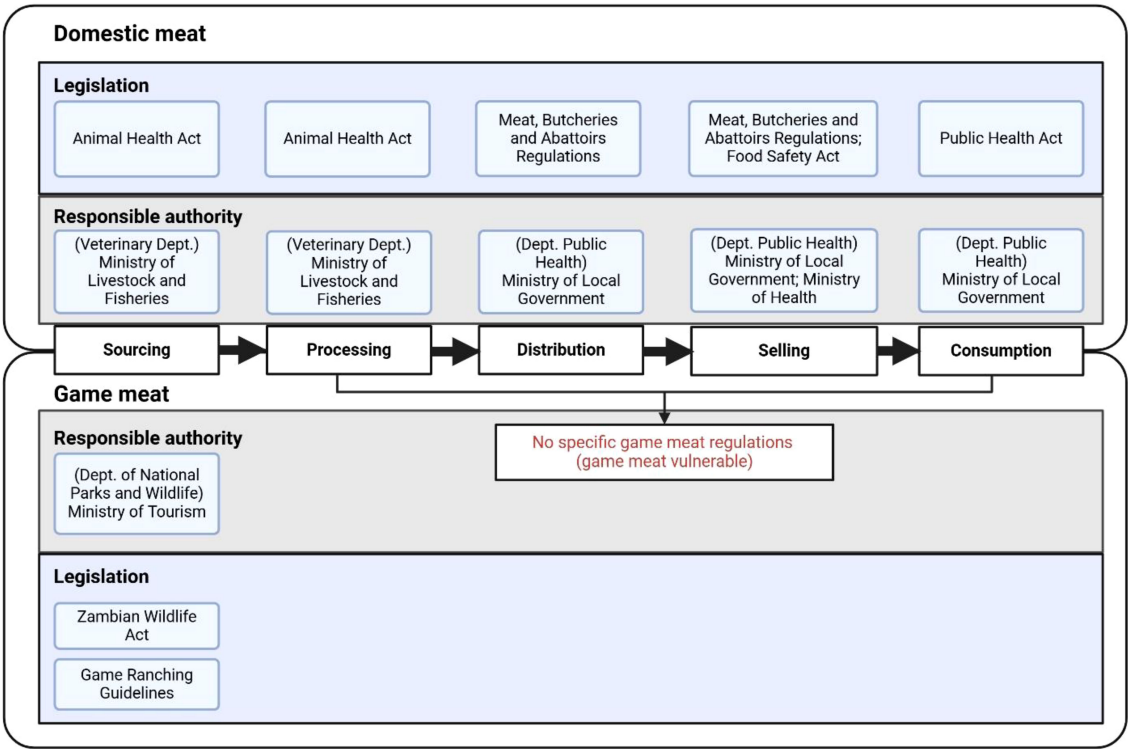


FIGURE 3
Summary of meat regulations and guidelines in Zambia, responsible authorities, and their scope according to policy analysis. Dept., Department.
Created in <https://BioRender.com>.

measures necessary or prescribed for disease control and animal infection. The Act further empowers the officer the power to destroy or order the destruction, recall, destroy, detain or dispose of, obtain a sample for testing, suspend, temporarily partially, or completely close premises. The Act does not include specific regulations that regulate game meat safety and zoonosis.

3.1.2 Animal Health Act of 2010

The mandate of the Animal Health Act of 2010 is to “provide for the prevention and control of animal diseases; provide for the quarantine of animals, regulate animal products and animal by-products.” In the meat supply chain, it regulates the sourcing and processing of animal meat in Zambia. The custodian of the Act is the Ministry of Livestock and Fisheries, and it is enforced by the Department of Veterinary Services (Figure 3). The Act defines an animal as “any vertebrate, other than a human being, which is a member of the *Phylum Chordata* and includes a bee, butterfly, and other insects used in the production of animal products, including the carcass of such animals.” The Act defines an animal product as “a meat product or product of animal origin for human consumption, for use in animal feeding, or for pharmaceutical or agricultural use, and includes an embryo, ova, semen, blood, bone or bone meal, hide, skin, horn, fat, honey, unprocessed wool, and feathers.” Livestock is defined as “any breed or population of animal kept by a human being for a useful or commercial purpose and includes domestic animals, semi-domestic animals, and captive wild animals.” Considering that the Act does not specifically define game or wildlife, the coverage of these subjects is left to interpretation. It can be concluded that the Act does not have specific regulations governing game and game meat.

3.1.3 Public Health Act (Meat, Abattoir, and Butcherries Regulations) and the Food Safety Act of 2019

This Act regulates the operations of abattoirs and butcherries in Zambia. The regulations are enforced by the Public Health Department, under the Ministry of Health (Figure 3). In the meat industry, they cover processing and selling. The Public Health Act (Meat, Abattoirs, and Butcherries regulations) defines an animal as “ox, bullock, cow, heifer, steer, calf, sheep, lamb, goat, or other quadrupeds commonly used for the food of man.” Meat is defined as “the flesh, or offal or other parts used or intended for the food of man derived from any animal as defined above but does not include canned meat, potted meat, bacon, or ham.”

The Food Safety Act of 2019 mandate is to “provide for the protection of the public against health hazards and fraud in the manufacture, sale, and use of food; provide for a streamlined process for regulatory clearances for regulatory health requirements for food premises.” The Ministry of Health is the custodian of the Act, and it is enforced by the Department of Public Health (Figure 3). In the Food Safety Act of 2019, animal and animal products have the same meaning as assigned in the Animal Health Act of 2010. The Act gives provisions for regulations, standards, and statutory instruments.

3.1.4 National Livestock Development Policy of 2020

This policy document is relevant to this analysis because game is defined under livestock according to the Animal Health Act of 2010. The policy covers game as non-conventional livestock. The coverage is viewed from an investment perspective. Disease control and quality control standards focus on domestic livestock. The policy, however, states that there is a lack of clear policy on game as indicated by this direct quote: “The key constraints limiting non-conventional livestock include poaching, high startup costs, lack of a clear policy on non-conventional livestock, difficulty of accessing land for game ranching, and limited research and extension.”

3.2 In-depth interviews

The main goals of the in-depth interviews were to verify the findings of policy analysis with respect to the availability of specific game meat regulations and to clarify if there are any control mechanisms or practices that are being employed to manage game meat safety and zoonosis. Figure 4 illustrates the summary of game meat control mechanisms concerning regulations, codes, or standards along the supply chain, as revealed by the key informants.

3.2.1 Inspection

3.2.1.1 Game movement

To illustrate game movement control concerning zoonosis, we provide an illustration of a typical game movement process as coded from the key informants' interviews (Figure 4). If farmers or ranchers want to move the game, the head of the veterinary department is contacted. For example, if farmers want to move buffaloes, they must contact the wildlife veterinary department, which will advise them that testing is mandatory for buffaloes. Hence, field officers are instructed to go and test for diseases of national importance (e.g., foot-and-mouth disease for buffalo). At a private ranch or farm, a practicing wildlife veterinarian visits the ranch. This is because field veterinarian staff lack the competencies to perform certain tests. In some circumstances, a team from the central national laboratory can conduct the tests. After the animals have been cleared, both the selling and receiving districts are advised to proceed or not, depending on the outcome of the tests. According to interviewees, since there are no game regulations pertaining to game movement, livestock regulations are used.

“So, on regulations, we are still working on them. The regulations that we are currently using are the livestock regulations, so considering that the individual who is advising has the knowledge of both livestock and game, they provide good advice.”

Interviewees revealed that the trade of game and game meat falls under the Ministry of Tourism and Natural Resources by law. Animal diseases and game meat safety fall under the veterinary

REGULATION AND CONTROL OF GAME MEAT SUPPLY CHAIN

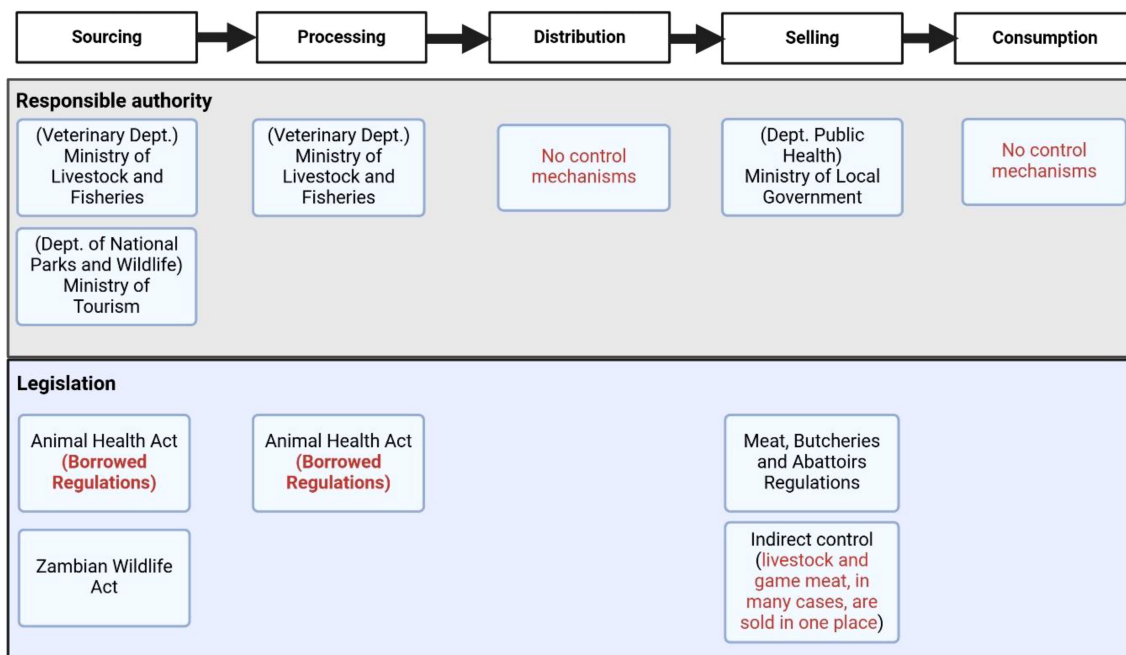


FIGURE 4

An illustration of the regulation and control of game meat along the supply chain as revealed by key informants. Borrowed regulations: regulations meant for domestic animals and meat trade that are being used for game meat in that particular supply chain stage. Dept., Department. Created in <https://BioRender.com>.

provision of the Ministry of Livestock and Fisheries. This was reported to cause challenges regarding regulation.

control measures are put in place to ensure the food safety of game meat.

“The challenge with the management and regulation implementation is we have the veterinary provision that falls by law under the Ministry of Tourism, Environment, and Natural Resources, but the authority for animal diseases, which includes wildlife, is under the Ministry of Fisheries and Livestock.”

Interviewees reported that veterinary surgeons in the Ministry of Tourism and Natural Resources are primarily there to support conservation activities, and secondarily, to address food safety and zoonotic needs.

3.2.1.2 Farmed game meat (ante-mortem and postmortem)

Interviewees reported that there are no farmed game meat regulations. Hence, for control, the Animal Health Act of 2010 (which is more biased towards livestock) is used. It was pointed out that regulations governing game and game products have since been drafted to be part of the Animal Health Act but not yet assented to be a legal body by the time this paper was written. Interviewees highlighted that even in the absence of game meat regulations, some

“Now, coming to your case when we are dealing with game products. What we are doing is still using the Animal Health Act of 2010, which is more biased towards livestock. We have to put measures in place to ensure that the product coming out of wildlife is wholesome and fit for human consumption.”

To understand zoonosis control mechanisms implemented by the authorities for farmed game meat, the practices that are put in place, from hunting to when the meat leaves the farm, were coded. The study revealed that, similar to livestock, an ante-mortem inspection is done before the animals are slaughtered. Most of the time, the department does a health assessment in private wildlife estates or game ranches. A health clearance certificate is provided to the game ranch. Officers visit the game ranch and inspect it. The inspection requires knowing the farmed species, the management of the ranch, and the biosecurity measures implemented by the game ranch, starting with fencing, the location, and then other facilities that are present. A standard questionnaire is used for the assessment. Another factor that is considered is whether the farm has a private veterinarian who attends to injured animals or attends to any diseases. During the assessment, much attention is given to

animal species that host diseases of national economic importance, which are derived mainly from livestock. Species of interest are mainly buffaloes and warthogs. For buffaloes, the focus is foot-and-mouth disease, while for warthogs it is African swine fever. Depending on the management system or what is found during the game ranch assessment, a certificate is given to the ranch. The maximum validity is 1 year, whereas the minimum validity will depend on the outcome of the assessment based on the management system and the presence of species that are hosts to diseases of national economic importance. After the certificate has been issued, the ranch is advised that the assessment acts as an ante-mortem tool. This means they can directly cull the animals after they are farmed. Officers will then perform the routine meat inspection after harvest.

The veterinary department agreed that a significant amount of work needs to be done to fully regulate the game meat industry in terms of ensuring game meat safety for human consumption. Interviewees reported that efforts regarding regulations are being made.

“We drafted the regulations governing wildlife and wildlife products in 2021 so that they can be part of the Animal Health Act of 2010, which is the law that governs the service of veterinary service provision in the country. But they are still at the consultative phase.”

3.2.1.3 Wild game meat (post-mortem)

To understand if any zoonosis control mechanisms are implemented by the authorities regarding wild game meat, the practices that are used were coded from the typical place from hunting to when the meat leaves the forest. According to interviewees, animals are shot in a GMA.

“Now in the natural protected areas, which are our game management areas, where cropping is allowed, since the law stipulates that you do not shoot animals from a national park, but rather from a game management area, which is part of the park, but where cropping is allowed.”

The hunters and the wildlife veterinary department liaise with national parks. The national parks will notify the veterinary department that they have issued hunting licenses during hunting seasons from September to December. The department knows that the main disease of concern in the Luangwa ecosystem is anthrax, and the species that are mainly of concern are hippos and buffaloes. Hunters pass through specific GMA exit points where veterinarian officers are present. The officers inspect the carcasses to determine if the minimum health requirements are met and if the meat is fit for human consumption. Reportedly, hunters also enter the GMA during the non-hunting season when no veterinary officers are at

the exit points. In this scenario, the animal is shot, processed, and delivered to butcheries or taken home without inspection.

It was pointed out that inspections are sometimes not undertaken due to the remoteness of some of the GMA areas. The example of Nyika National Park was given. In these circumstances, the hunter must make a judgment regarding meat safety. Another challenge that was reported is the lack of laboratory equipment to perform advanced tests. Game meat that should go under microscopic screening is being screened via visual observation.

3.2.2 Selling

It was reported that three ministries are involved in game meat selling: the Ministry of Tourism, the Ministry of Local Government, and the Ministry of Health. Their involvement concerns the provision of certifications and permits. The Ministry of Tourism, through the DNPW, issues permits to hunters (as mentioned under policy analysis). This permit allows them to sell to individuals or butchers. However, butchers should obtain two permits: certification of ownership of a trophy, which allows the trader to possess game meat, and a permit that allows them to sell game meat. Both are issued by the DNPW. The selling permit contains the species that is being sold and the kilograms received from the supplier hunter or rancher. If a butcher is selling the meat, the butcher requires a health permit from the local government (city council), which is renewed annually. The permit is not specifically for game meat but for any premises that are selling meat.

The Ministry of Health, which is the custodian of the Food Safety Act of 2019, and the Ministry of Local Government, which together are the custodians and enforcers of the Meat, Abattoir and Butcheries Regulations, reported that the selling of game meat is not regulated. The Ministry of Health pointed out that it does not recognize the game meat trade as formal. This is regardless of it being legalized by the Zambia Wildlife Act of 2014. However, the Ministry of Health indicated that due to increases in zoonotic outbreaks, there is a need to have game meat regulations. The Ministry of Local Government was not aware that game meat is being traded legally in Lusaka Town, which is concerning considering that they are the ones responsible for inspections. It was reported that game meat is being sold in the same butchery as domestic meat, and these butcheries are occasionally inspected by meat inspectors. Yet when the local government was interviewed, they reported that they were not aware that game meat is being traded legally in Lusaka Town, regardless of having butcheries that are selling game meat legally in Lusaka City. It was also noted that butcheries do not differentiate whether the game meat they sell is farmed or wild.

3.2.3 Traceability

Regarding traceability, one of the informants reported that:

“So, for traceability, on the license, there is a section that is signed by the hunter and one of the officers who escorted the hunter; this section needs to be verified by the local officers who are

either the area warden or the ranger. So the area warden or the ranger will verify and they will check how many heads and hooves are there and allow the hunter to proceed.”

All the information gathered by the warden and rangers is reported to wildlife headquarters. It was reported that the challenge is that the DNPW gives out permits to everyone who wants a permit to sell and does not follow up to check the source of meat. When someone wants to start selling game meat, one of the requirements is to put the supplier's name, i.e., who is going to be supplying the game meat. It was reported that several prospective sellers use the contact details of legal suppliers during the application to satisfy the requirements. Once they obtain their permit, they will then never report to the offices again and do not update the supplier's details in case of changes. This makes traceability a huge challenge.

3.2.4 Training

Interviewees indicated that hunter training is done by the DNPW and that the training does not involve game meat handling. The study revealed that in GMAs, there are two prerequisites for hunting: possessing a licensed gun and being a professional hunter. The study revealed that there is an association called the Professional Hunters Association (PHS). In most of the game ranches, the clientele might not be trained hunters, but the owners of the game ranches are either trained hunters or they are the ones who employ trained hunters. Interviewees mentioned that if the clients want to shoot the animal themselves, they will be accompanied by a trained hunter. There are also freelance hunters who may have served in the military, and in some rare circumstances, wildlife police officers can also assist with shooting.

4 Discussion

4.1 Policy analysis

4.1.1 Zambia Wildlife Act of 2015

To determine if the Zambia Wildlife Act of 2015 covers the game meat trade, it is a matter of the presence of certain terms in the Act, i.e., game meat and wild meat, and how they are defined. How an animal is defined is also important as it establishes which species are covered by the Act. Defining game meat as a trophy makes the interpretation unclear. The lack of clarity has consequences for the general population in interpreting the law, and this may bring challenges in enforcement. The Minister has the power to regulate trade or movement of meat or game animals or protected wildlife. The Act criminalizes hunting without a license, possession to sell without a license, and the buying of game animals or meat to sell without certification. These measures control zoonotic risk as hunting permits are issued by the DNPW, and the department does not issue permits to hunt in high-risk areas (e.g., areas experiencing disease outbreaks). The power to recall a product and test and destroy it also increases game meat safety and reduces zoonotic transmission. It is important to note that the Act regulates sourcing and selling mainly from a conservation vantage point.

Other countries' conservation Acts, for instance, the South African National Environmental Management: Biodiversity Act of 2004, have a section of professional hunting courses. This section encompasses how to conduct training, reassessments, and examinations of hunters. This is important because proper training enhances game meat safety and reduces zoonosis spillage (Branciarini et al., 2020; Gaviglio et al., 2018).

Interviewees reported that the Zambian regulation allows hunting provided that the hunter holds a permit. When hunting is done, the surrounding rural and marginalized communities are also given a share of the game meat (Lindsey et al., 2013). This practice allows these marginalized groups to have access to wildlife resources (Treves et al., 2019), which is a much-needed source of protein. This means the law and the practice both serve environmental justice as there is a certain balance in resource use, especially if a comparison is made with countries that do not allow hunting (Damm, 2008). In addition, regulated hunting ensures sustainable management of game species, which can also lead to a reduction in animal-wildlife-human interactions (Baskin, 2016). All these factors contribute to environmental justice.

4.1.2 Animal Health Act of 2010

The scope of the Animal Health Act of 2010 regarding game and game meat is a function of how the term animal is defined. The Act does not clearly state game or wildlife; it only mentions the word vertebrate. It can reasonably be said that it does include game animals. The problem is that, when the law is left to interpretation, it can have ramifications in enforcement. The inclusion of game in the definition would have made things clear considering that game animals are usually not covered by regulations that cover domestic animals (World Bank, FAO, 2022a; Broad, 2020). This lack of clarity may create an enforcement loophole. The FAO (1983) points out that a lack of clear terms and certainty in laws deprives the public of protections. The definition of game animals under livestock shows how domestic livestock is prioritized in regulations over game animals. In addition, by only mentioning captured game animals, non-captured game animals are not covered by the Act. The lack of specific regulations for the mentioned captive game shows that the game is included by definition. This means that game meat is vulnerable to contamination by zoonotic pathogens during sourcing and processing. This reflects both the history and primary purpose of animal health laws, which is to protect domestic animals and not the health of wild animals (World Bank, FAO, 2022a, 2022).

4.1.3 Public Health Act (Meat, Abattoir and Butcheries Regulations) and the Food Safety Act of 2019

How the Public Health Act (Meat, Abattoir, and Butcheries Regulations) covers game and game meat is a matter of how the animal is defined in the Act. The Act defines 'animal' as a quadruped (meaning four-legged animal), thus not providing clarity as to the specific species covered under the Act. This makes application and enforcement challenging. The regulations

do not have specific game meat regulations that cover the game meat chain in the same way that the Meat Inspection and Control of Red Meat Abattoir Regulations of Botswana do (Botswana, Livestock and Meat Industries Act of 2007). The lack of specific regulations or guidelines that control the supply chain may increase zoonosis risks. Game meat should conform to hygiene regulations if it is entering the commercial market (Needham et al., 2023). To determine if the Food Safety Act of 2019 covers game meat, how animal and animal products are defined in the Act needs to be considered. ‘Animal’ and ‘animal products’ in the Food Safety Act of 2019 have the same meaning assigned to the definitions in the Animal Health Act of 2010. These definitions reference the Animal Act without further clarification, leaving the application of the term game meat open to interpretation. The Act provides provisions for regulations, standards, and statutory instruments. However, currently, there are no regulations or standards that regulate game meat. The lack of game meat standards or specific regulations that regulate the selling and marketing of game meat increases zoonotic risks. Looking at Southern Africa, only South Africa has game meat standards. These are the Standards for the Microbiological Monitoring of Meat, Process Hygiene, and Cleaning (VPN/15/2010-01), which are for exported game meat. Namibia, in their Guidelines for the Harvesting and Processing of Wild Game in Namibia of 2016, has microbiological limits.

4.1.4 National Livestock Development Policy of 2020

The National Livestock Development Policy covers game, defining it under non-conventional livestock. Its coverage is from an investment point of view. Disease control and quality control standards focus on domestic livestock. This indicates that it is biased towards domestic livestock. The production of game and game products cannot be compared with the production of domestic animals in terms of numbers but considering the frequency of zoonotic outbreaks; strategies must also cover game and game products for the safety of public health.

4.2 In-depth interviews

4.2.1 Inspection

4.2.1.1 Game movement

As reported, the lack of competence of field officers is common in developing countries. Nkosi et al. (2023) highlighted that in many developing countries, there are not enough trained staff to undertake inspections of game, whilst laboratories to help with the diagnosis of possible hazards are even more scarce. The lack of competence and resources likely increases the zoonotic risks, especially if veterinarians are unable to detect diseases of importance in time. Furthermore, the focus of veterinary surgeons is mostly on conservation, and less on food safety and zoonosis. This indicates a bias and low level of priority towards food safety issues. Wei (2020) pointed out that governments should start to pay more attention to food safety issues related to the game.

4.2.1.2 Farmed game meat (ante-mortem and postmortem)

The lack of specific game meat regulations likely increases zoonotic risks, as regulations, (together with proper enforcement) prevent the distribution of contaminated meat products. The effort to draft game regulations is an important step towards controlling zoonotic risks in game meat and increasing its safety. The realization that there is a considerable amount of work that needs to be done to normalize the game meat industry in terms of game meat safety for human consumption is a good step in the right direction. However, a realization of the need to increase game meat safety and the drafting of specific game meat regulations is not enough. There is a need for commitment from relevant stakeholders so that the regulations come into force. If these regulations are not prioritized, they may take a long time to be approved. For instance, in South Africa, game meat regulations were drafted in 2004 (van Der Merwe et al., 2011), and at the time our paper was written, they had not yet been approved.

4.2.1.3 Wild game meat (post-mortem)

The practice of introducing game meat without inspections was reported by key informants. This practice likely increases zoonosis risk. The same practice was also highlighted in Abrantes et al. (2023). Philavong et al. (2020) pointed out that part of the game trade operates outside the official distribution chains and therefore bypasses slaughterhouses where inspections and testing for potential infectious agents would normally be carried out, which is the same for Zambia. The practice of telling hunters where they can find veterinarian staff who can perform inspections after hunting (as found in this study) was also mentioned by Gaviglio and colleagues (Gaviglio et al., 2018). Regarding the situations where game meat is not inspected at the exit, Casoli et al. (2005) reported that in many cases, wild game does not undergo any official examination. A study that was done by Olivastri and colleagues (Olivastri et al., 2021) showed the importance of post-mortem inspections and the central role of the competent authority in ensuring the food safety of game meat. A lack of resources increases game meat risks and decreases game meat safety as game meat will gain entry into the market without proper inspection. The lack of resources was also pointed out by Mendelson et al. (2003) as an impediment to compliance associated with state regulation in the Ghana Wildlife Department.

4.2.2 Selling

The lack of awareness among inspectors regarding the sale of game meat by butchers is probably because inspections are guided by regulations. Hence, the absence of specific regulations addressing game meat leads to the assumption that game meat is not being sold. Failure to distinguish between farmed and wild game during selling can mislead customers, as well as make it difficult to track the source of zoonotic origin. An interim guideline published by the WHO, WOA, and FAO in 2021 highlighted the need to distinguish farmed game from wild game as a traceability measure to reduce zoonotic risks (WHO, WOA, UNEP, 2021).

4.2.3 Traceability

The informants revealed that the current game traceability system is mainly focused on conservation to allow passage at roadblocks. It does not focus on zoonosis or game meat safety. It also does not record the health status of the killed animal back to the farm, the same way the South African system does for exported game meat (Hoffman and Wiklund, 2006). The lack of a traceability system that is zoonotic and game meat safety-oriented makes it difficult to manage zoonotic outbreaks if they occur. The WHO, WOA, and FAO in 2019 stressed the importance of traceability systems in game meat supply chain systems as a mechanism to manage zoonotic diseases (WHO, WOA, UNEP, 2021). The same was suggested by Petrovan and colleagues (Petrovan et al., 2021) in a review. Poor traceability systems make it difficult to track and trace the origin of a zoonotic outbreak (Campbell et al., 2021), which in turn makes it challenging to protect public health.

4.2.4 Training

The study found that hunters are not trained to handle game meat. This practice likely increases zoonotic risks through occupational exposure. Incorporating training limits exposure, which protects the workers from the working environment. Korkmaz et al. (2022) recommended that the training of hunters should include both shooting training and game meat safety training. According to the European Regulation (EC) No. 853/2004 for food derived from animals, at least one person from a team must know the normal anatomy, physiology, and behavior of game animals as well as be able to ascertain abnormal behavior and pathological changes caused by disease, environmental contamination, or other factors, which may affect human health after consumption. Gaviglio and colleagues (Gaviglio et al., 2018) emphasized that, in any supply chain, the chain of game meat should start with a trained hunter. A trained person has juridical responsibility, which is required to transmit and make people aware of food safety preventive measures and the unhygienic handling of meat (Abrantes et al., 2023). The same is also mandated in South Africa by the National Environment Management Biodiversity Act of 2004. A study that evaluated the contamination of roe deer carcasses during animal control in central Italy (Branciarini et al., 2020) concluded that training hunters who carry out procedures, such as bleeding and evisceration, is necessary to prevent carcass contamination. Zottola and colleagues (Zottola et al., 2013) pointed out that the choice of a well-trained hunter for the season and the hunting method are important. Ranucci and colleagues (Ranucci et al., 2021) reported that proper training of hunted wild boars influenced the lower average microbial loads. Training in good hygiene practices while handling and dressing game meat resulted in low *Enterobacteriaceae* counts in a study conducted by Mirceta and colleagues (Mirceta et al., 2017).

4.3 International perspective in this Zambian case study

Zambia is only one of many countries contributing to the international trade in game meat through importation from

South Africa and Namibia (FAO, 2024). In this section, we provide a brief overview of the policy perspective for international trade. The environmental justice issues discussed as applicable at the national level are magnified across the extent of the complex international trade pathways.

Regarding the regulation and control of game meat safety from an international perspective, the Codex Alimentarius Commission (CAC) (an organization operated by the WHO and FAO to create and maintain international food standards to protect public health and ensure fair trade practices) published the *Code of hygienic practice for meat CAC/RCP 58-2005*, which covers game meat safety along all the supply chain stages. However, it does not specifically cover zoonosis. Countries that do not have the game meat regulations/guidelines can adopt the code into law; once adopted, it can be used as it is or adjusted to fit the local context; if it is adopted, it can only work at a national scale. The FAO has established technical guidance principles for risk-based meat inspection and their application. The technical document mentions the game in passing under elements that should be incorporated in meat inspection legislation, stating that “when applicable, there should also be a provision for the hunted game” (FAO, 2021). The guidelines do not explain how the principles work in the context of game meat. Specific game regulations and guidelines at the international level are lacking. Hence, the international game meat trade is regulated through bilateral agreements (Department of Forestry, Fisheries and the Environment, South Africa, 2023). The bilateral agreements include the game meat safety criterion that the exporting country should meet. If they do not meet the specific criterion, the arrangement is canceled. For example, Russia banned importation of kangaroo meat due to high *Escherichia bacteria* (Ben-Ami et al., 2010).

The World Trade Organization (WTO) mandates the WOA within its Sanitary and Phytosanitary Agreement (SPS Agreement), as the international reference organization for setting standards for the international trade in animals and animal products (Brückner, 2009). Trade between countries is through bilateral agreements that are guided by this SPS Agreement. (Figure 5). As a result of these measures, the risk of zoonotic spillover along the game meat supply chain can be minimized, considering that all the ministries and departments (Figure 5) have control measures in place. However, it is important to point out that risk minimization depends on whether the measures are being implemented and the necessary resources for the implementation are available.

When game meat that is sourced legally in countries that allow hunting and trading of game meat (this case study) or sourced from countries where regulations are unclear (van Vliet et al., 2019) is smuggled via airports or borders (Morrison-Lanjouw et al., 2023), it likely increases zoonotic risks because border control measures are avoided. When this game meat, despite being sourced legally, crosses the borders, it becomes illegal. To prevent this kind of trade, the focus needs to be placed on the regulation and control of sourcing and customs (Figure 5). A study conducted by Chaber and colleagues (Chaber et al., 2023) focused on international wild meat traffic into Belgium. The researcher found that Nigeria and Uganda were some of the key countries from which the meat originated. By investigating the regulations of wild meat in Nigeria, Akpan and

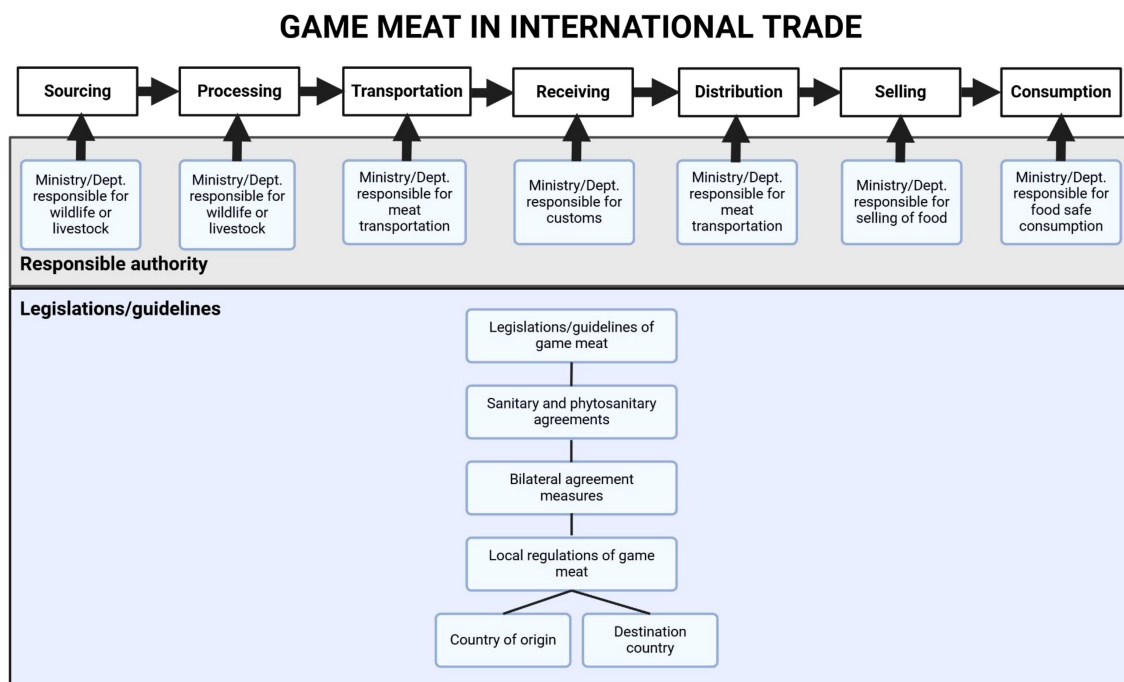


FIGURE 5

An illustration of game meat in international trade, including possible ministries or departments (depending on the country) and current international legislations or guidelines. Dept., Department. The arrows indicate the movement of the meat from the source. Created in <https://BioRender.com>.

colleagues (Akpan et al., 2025) revealed a lack of regulations in the wild meat supply chain. Hence, this could be one of the contributing factors to its international trade and trafficking. Conversely, Uganda has hunting and game meat trading regulations (The Uganda Wildlife Statute of 1996), yet it was also reported as a source. This could be a result of enforcement or lack of knowledge regarding the illegality of import of personal consignments of meat from third countries into the European Union (Chaber et al., 2023). Hence, on top of regulations and enforcement, it is important to educate people regarding these trafficking practices.

4.4 General recommendations

Based on the findings of this study, the use of the zoonotic control framework (Figure 2) is proposed as the basis for developing regulations for game safety and zoonosis prevention along the game meat supply chain in Zambia. All the components in the framework can increase game meat safety and mitigate zoonotic transmission, thereby improving environmental justice. The framework is made up of three components: inspections (which are subdivided into four elements: (biosecurity, post-mortem and ante-mortem, product distribution and selling), traceability, and training.

Biosecurity protects animal and human health. Ante-mortem inspections help in identifying diseased animals so that they are not slaughtered. Post-mortem inspections, distribution, and selling of game meat-specific regulations prevent the distribution of

contaminated meat products that could give rise to zoonotic disease in humans (FAO, 2021). In addition, the regulations should cover traceability through the monitoring of critical points in the supply chain to gather data on where, how, and under what conditions the game meat is being produced and traded (Campbell et al., 2022). Furthermore, they should also include personnel training. Ideally, the training should encompass game pathology, the production and handling of game meat after hunting, and the undertaking of a first examination of wild game on the spot (EC No 853/2004). All these are important in preventing zoonotic spillover. Creating regulations alone is not enough. The government should allocate more resources to responsible ministries. These resources should support infrastructure, financial needs, and personnel needs, ultimately benefiting enforcement.

The One Health concept that integrates human, animal, and environmental health should be practiced by all the ministries involved in the supply chain to improve game meat safety and prevent zoonosis. If this concept is adopted by the Ministry of Tourism and Natural Resources and the Ministry of Livestock and Fisheries, this can avoid delays and expedite the approval of the game and game regulations that can address the concerns raised in this study.

5 Conclusion

There are no specific regulations governing game meat safety in Zambia. Domestic livestock and meat regulations are being borrowed

from other regulatory frameworks and used to control game meat safety along the domestic supply chain. Game meat control is only occurring at the first stage (i.e., sourcing) of the supply chain, while the rest of the chain remains uncontrolled. Game meat is being sold in the same butcherries that also sell domestic livestock. From the lens of environmental justice, the Wildlife Act of 2015 is serving environmental justice. The Animal Health Act of 2010 and the National Livestock Development are biased towards domestic livestock; hence, there is no equity in health prioritization between domestic and game animals. Consumers are not fully protected by the Public Health Act (Meat, Abattoir, and Butcherries Regulations) and the Food Safety Act of 2019. This study offers key insights into the regulation and control of farmed and wild game meat in Zambia. We recommend utilizing the zoonotic control framework to draft specific game meat regulations for the government and increase resources for responsible ministries. The framework can also be adopted by other countries in similar situations. In addition, the policy analysis methods employed in this study can contribute to a deeper understanding of game meat safety and, thus, environmental justice in other countries.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving humans were approved by Tropical Disease Research Centre (TDRC) Research Ethics Committee, Ndola, Zambia. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

BM: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Resources, Software, Validation, Visualization, Writing – original draft, Writing – review & editing. FS: Writing – review & editing, Visualization, Validation. SE: Writing – review & editing, Visualization, Validation.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fcsc.2025.1541179/full#supplementary-material>

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