International Journal of
Livestock Policy
(IJLP)

The Intersection of Livestock Production and Public Health: Policy Challenges and Solutions

CARI Journals

International Journal of Livestock Policy
ISSN: 2957-4382 (online)
Vol. 3, Issue No. 3, pp 1 - 15, 2024
www.carijournals.org

The Intersection of Livestock Production and Public Health: Policy Challenges and Solutions

[1*]Zawadi Kristina
University of Dodoma

Accepted: 14th April, 2024, Received in Revised Form: 9th May, 2024, Published: 4th, June, 2024

Abstract

Purpose: The general objective of this study was to explore the intersection of livestock production and public health, that is, policy challenges and solutions.

Methodology: The study adopted a desktop research methodology. Desk research refers to secondary data or that which can be collected without fieldwork. Desk research is basically involved in collecting data from existing resources hence it is often considered a low cost technique as compared to field research, as the main cost is involved in executive's time, telephone charges and directories. Thus, the study relied on already published studies, reports and statistics. This secondary data was easily accessed through the online journals and library.

Findings: The findings reveal that there exists a contextual and methodological gap relating to livestock production and public health. Preliminary empirical review revealed that comprehensive, interdisciplinary policies were necessary to address the multifaceted challenges posed by livestock farming. It emphasized the importance of frameworks like One Health, which recognize the interconnectedness of human, animal, and environmental health. The study highlighted the significance of stringent regulation and surveillance to manage public health risks, particularly concerning antimicrobial resistance and foodborne illnesses. Additionally, it stressed the need for continuous research and innovation to address evolving challenges, such as climate change and changing dietary preferences. Overall, the study underscored the importance of collaborative efforts to develop sustainable solutions that balance public health protection with economic and environmental considerations.

Unique Contribution to Theory, Practice and Policy: The One Health Theory, Risk Analysis Framework and Social-Ecological Systems Theory may be used to anchor future studies on the intersection of livestock production and public health, that is, policy challenges and solutions. The study provided several recommendations that contributed to theory, practice, and policy in the field. It emphasized the adoption of theoretical frameworks like One Health to better understand the complex interactions between human, animal, and environmental health. In practice, the study recommended implementing evidence-based strategies such as sustainable farming practices to mitigate public health risks associated with livestock production. From a policy perspective, it called for the development of comprehensive regulations and surveillance mechanisms to safeguard public health. Furthermore, the study highlighted the importance of international collaboration, research, and stakeholder engagement in addressing global challenges in this area. Overall, these recommendations aimed to promote sustainable livestock production while protecting public health and the environment.

Keywords: *Livestock Production, Public Health, Regulation, Surveillance, One Health, Sustainability, Stakeholder Engagement, Environmental Health, Zoonotic Diseases, Antimicrobial Resistance*

1.0 INTRODUCTION

Public health outcomes in the context of livestock production are influenced by numerous factors, including zoonotic diseases, food safety, antibiotic resistance, and environmental impacts. Zoonotic diseases, which are diseases that can be transmitted from animals to humans, pose a significant public health challenge. Examples include avian influenza, swine flu, and more recently, COVID-19, which is suspected to have originated from wildlife. The complexity of the livestock-human interface makes it difficult to control the spread of these diseases. Moreover, food safety concerns arise from the contamination of meat and dairy products with pathogens such as Salmonella, E. coli, and Listeria. These pathogens can cause severe foodborne illnesses and are a major public health concern. Antibiotic resistance is another critical issue, as the overuse of antibiotics in livestock can lead to the development of resistant bacteria, which can then infect humans. Environmental impacts, such as water pollution and greenhouse gas emissions from livestock production, also affect public health by contributing to climate change and contaminating water sources (Robinson, Wertheim, & Kock, 2014).

In the United States, public health outcomes related to livestock production are closely monitored by agencies such as the Centers for Disease Control and Prevention (CDC) and the Food and Drug Administration (FDA). One of the primary challenges is the control of zoonotic diseases. For instance, the CDC reports that approximately 60% of known infectious diseases in humans are spread from animals, and 75% of new or emerging infectious diseases are zoonotic (CDC, 2017). Food safety is another critical issue, with the CDC estimating that foodborne illnesses affect 48 million Americans annually, resulting in 128,000 hospitalizations and 3,000 deaths (CDC, 2018). Solutions to these challenges include implementing stringent biosecurity measures, improving surveillance and monitoring systems, and promoting responsible use of antibiotics in livestock production. Programs such as the National Antimicrobial Resistance Monitoring System (NARMS) play a crucial role in tracking antibiotic resistance trends and informing policy decisions to mitigate public health risks (FDA, 2020).

In the United Kingdom, public health outcomes associated with livestock production are managed by agencies such as Public Health England (PHE) and the Food Standards Agency (FSA). The UK has faced significant challenges with zoonotic diseases such as bovine tuberculosis and avian influenza. For example, the FSA reported a rise in cases of Campylobacter infection, a common foodborne illness associated with poultry, affecting over 500,000 people annually (FSA, 2019). The UK government has implemented various measures to address these challenges, including the "UK Five-Year Antimicrobial Resistance Strategy," which aims to reduce antibiotic use in livestock and improve infection prevention and control (Department of Health and Social Care, 2019). Additionally, the UK has invested in research and development of vaccines and alternative treatments to reduce reliance on antibiotics and improve animal health, thereby protecting public health.

In Japan, the Ministry of Health, Labour and Welfare (MHLW) oversees public health outcomes related to livestock production. Japan has encountered challenges with zoonotic diseases such as influenza and foodborne illnesses caused by pathogens like E. coli and Salmonella. The MHLW reported that foodborne outbreaks, particularly those linked to raw or undercooked meat, have been a persistent issue (MHLW, 2017). To combat these challenges, Japan has implemented strict food safety regulations and advanced monitoring systems. The country has also focused on reducing antibiotic use in livestock through the "Action Plan to Combat Antimicrobial Resistance," which sets targets for reducing antimicrobial usage in animals and promotes research into alternative treatments (MHLW, 2016). Additionally, Japan has invested in public awareness campaigns to educate consumers and producers about safe food handling practices and the risks associated with antibiotic resistance.

In Brazil, the Ministry of Health and the Ministry of Agriculture, Livestock, and Food Supply (MAPA) are responsible for public health outcomes related to livestock production. Brazil faces significant challenges with zoonotic diseases such as brucellosis and leptospirosis, as well as foodborne illnesses. A study published in the Brazilian Journal of Infectious Diseases highlighted that brucellosis remains endemic in several regions, posing a risk to both animal and human health (Poester, Samartino, & Santos, 2013). To address these issues, Brazil has implemented vaccination programs and surveillance systems to monitor and control disease outbreaks. Additionally, Brazil's National Plan for the Control of Residues and Contaminants (PNCRC) aims to ensure food safety by monitoring residues of veterinary drugs and contaminants in animal products. The country has also focused on improving biosecurity measures and promoting good agricultural practices to mitigate the risks of disease transmission and enhance food safety.

In many African countries, public health outcomes related to livestock production are managed by national health ministries and agricultural agencies. African countries face unique challenges due to the prevalence of zoonotic diseases such as Rift Valley fever, anthrax, and brucellosis, which can have severe impacts on both human and animal health. The World Health Organization (WHO) has reported that Rift Valley fever outbreaks in East Africa have resulted in significant human morbidity and mortality, as well as economic losses (WHO, 2016). To address these challenges, African countries have implemented various strategies, including vaccination campaigns, improved disease surveillance, and public health education programs. Additionally, organizations such as the African Union's Interafrican Bureau for Animal Resources (AU-IBAR) work to enhance veterinary services and promote regional cooperation in disease control. Efforts to improve food safety and hygiene practices are also critical, given the high burden of foodborne illnesses in the region.

Global trends indicate that zoonotic diseases are an increasing threat to public health due to factors such as globalization, climate change, and changes in land use. The One Health approach, which recognizes the interconnectedness of human, animal, and environmental health, has gained traction as a comprehensive strategy to address these challenges. According to the World Organisation for Animal Health (OIE), adopting the One Health approach can enhance surveillance, improve disease prevention and control, and foster collaboration among various sectors (OIE, 2019). This approach has been implemented in various countries to varying degrees, with notable successes in reducing the incidence of zoonotic diseases through coordinated efforts. For instance, integrated surveillance systems and joint response teams have been effective in managing outbreaks of diseases such as avian influenza and Rift Valley fever.

Antibiotic resistance remains a critical challenge in public health, exacerbated by the overuse of antibiotics in livestock production. The World Health Organization (WHO) has identified antimicrobial resistance as one of the top 10 global public health threats (WHO, 2020). To combat this issue, countries have implemented national action plans to promote the prudent use of antibiotics and reduce the prevalence of resistant bacteria. For example, the European Union has banned the use of antibiotics as growth promoters in livestock since 2006, leading to a significant reduction in antibiotic use (European Medicines Agency, 2019). In the United States, the FDA has implemented guidelines to limit the use of medically important antibiotics in livestock, promoting their use only for therapeutic purposes under veterinary supervision. These measures, combined with ongoing research into alternative treatments and improved infection prevention practices, are essential for tackling antibiotic resistance and protecting public health.

Ensuring food safety is a fundamental aspect of public health, particularly in the context of livestock production. Contaminated meat and dairy products can cause severe foodborne illnesses, leading to significant health and economic burdens. To enhance food safety, countries have implemented stringent regulations and monitoring systems. In the United States, the USDA's Food Safety and

Inspection Service (FSIS) conducts regular inspections and enforces standards for meat, poultry, and egg products. Similarly, the European Union has established comprehensive food safety legislation, including the General Food Law, which sets out principles and requirements for food safety and hygiene (European Commission, 2019). These regulatory frameworks are supported by scientific research and risk assessments, ensuring that food safety measures are based on the best available evidence. Public awareness campaigns and education programs also play a crucial role in promoting safe food handling practices among consumers and producers.

Sustainability is a key consideration in addressing public health outcomes related to livestock production. Environmental impacts such as water pollution, greenhouse gas emissions, and habitat destruction can have direct and indirect effects on human health. To promote sustainability, countries have implemented policies and programs that encourage the adoption of environmentally friendly practices in livestock farming. For instance, Brazil's Low Carbon Agriculture Program (ABC Program) promotes practices such as integrated crop-livestock-forestry systems and improved pasture management to reduce greenhouse gas emissions and enhance soil health. In the European Union, the Common Agricultural Policy (CAP) supports sustainable farming practices through various incentives and funding mechanisms. These efforts are crucial for mitigating the environmental impacts of livestock production and ensuring the long-term health and well-being of both people and the planet.

Livestock production policies are essential in guiding the development, regulation, and sustainability of livestock sectors globally. These policies typically aim to improve livestock productivity, ensure animal welfare, and promote economic growth in rural areas (Otte, Roland-Holst, Pfeiffer, Soares-Magalhaes, Rushton, Graham & Silbergeld, 2012). Key components often include the regulation of animal breeding practices, health management, and market access. Policymakers must balance economic goals with environmental sustainability and public health considerations. As the demand for livestock products increases, driven by population growth and rising incomes, comprehensive frameworks are required to address the diverse and evolving challenges facing the sector (Thornton, 2010). Effective livestock policies can significantly contribute to rural development and poverty alleviation. Livestock farming is a critical source of livelihood for millions of smallholder farmers worldwide. Policies that provide access to credit, subsidies, and training programs can enhance productivity and income levels for these farmers (Herrero, Thornton, Power, Bogard, Remans, Fritz & Havlík, 2014). Moreover, improved livestock production can stimulate related industries, such as feed production and veterinary services, creating additional employment opportunities. However, economic benefits must be weighed against potential negative impacts, such as market volatility and the risk of over-reliance on livestock production (Staal, Poole, Baltenweck, Mwacharo, Romney, Herrero & Thorpe, 2009)..

Animal health is a cornerstone of livestock production policies. Effective disease control measures, including vaccination programs and biosecurity protocols, are crucial for preventing outbreaks of infectious diseases that can devastate livestock populations and impact human health (FAO, 2013). Zoonotic diseases, which can be transmitted from animals to humans, pose a significant public health risk. Policymakers must ensure that livestock health management systems are robust and capable of responding to emerging health threats. International cooperation is often necessary to address transboundary animal diseases (Grace, Mutua, Ochungo, Kruska, Jones, Brierley & Kang'ethe, 2012). Livestock production has significant environmental implications, including greenhouse gas emissions, land degradation, and water use. Policies promoting sustainable livestock practices are vital for mitigating these impacts. Strategies may include encouraging rotational grazing, improving feed efficiency, and integrating crop-livestock systems (Steinfeld, Gerber, Wassenaar, Castel, Rosales & de Haan, 2013). Environmental sustainability policies must also address the preservation of biodiversity and the protection of natural habitats. Balancing productivity with environmental

stewardship is a complex but necessary endeavor to ensure the long-term viability of livestock sectors (Gerber, Steinfeld, Henderson, Mottet, Opio, Dijkman & Tempio, 2013).

Ensuring the safety and quality of livestock products is a major focus of livestock production policies. Contaminants such as antibiotics, hormones, and pathogens must be rigorously monitored and controlled to protect consumer health. Regulatory frameworks often include standards for slaughtering practices, meat processing, and product labeling (WHO, 2015). Food safety policies must also address the traceability of livestock products from farm to table, ensuring that any issues can be quickly identified and rectified. Strengthening food safety systems is critical for maintaining consumer trust and preventing foodborne illnesses (Hoffmann, Batz & Morris, 2012). The use of antibiotics in livestock production is a significant public health concern. Overuse and misuse of antibiotics can lead to the development of antibiotic-resistant bacteria, which pose a serious threat to human health (Van Boeckel, Brower, Gilbert, Grenfell, Levin, Robinson & Laxminarayan, 2015). Policies aimed at regulating antibiotic use in livestock include restrictions on non-therapeutic uses and promoting alternatives such as improved hygiene and vaccination (Marshall & Levy, 2011). Public awareness campaigns and farmer education programs are essential components of these policies, ensuring that stakeholders understand the risks and adopt responsible practices (WHO, 2017).

Animal welfare is increasingly recognized as an important aspect of livestock production policies. Ensuring humane treatment of animals throughout their lifecycle is not only an ethical imperative but also contributes to improved productivity and product quality (Fraser, 2014). Policies may include regulations on housing conditions, transport, and slaughter practices. Animal welfare standards are often driven by consumer demand for ethically produced food, prompting policymakers to adopt more stringent regulations and enforcement mechanisms (Broom, 2017). Climate change poses significant challenges to livestock production, affecting animal health, productivity, and the availability of feed and water. Policies that promote climate-resilient livestock systems are crucial for adapting to these changes. This may involve the development of heat-tolerant breeds, improved water management practices, and the integration of livestock into broader climate adaptation strategies (Nardone, Ronchi, Lacetera, Ranieri & Bernabucci, 2010). Policymakers must also consider the socioeconomic impacts of climate change on livestock-dependent communities and develop support mechanisms to enhance their resilience (Thornton, van de Steeg, Notenbaert & Herrero, 2015).

The link between livestock production policies and public health outcomes is profound. Effective policies can mitigate risks associated with zoonotic diseases, foodborne illnesses, and antibiotic resistance, thereby protecting public health (Jones, Grace, Kock, Alonso, Rushton, Said & Pfeiffer, 2013). Conversely, poorly designed or implemented policies can exacerbate these risks, leading to significant public health challenges. Collaboration between agricultural and public health sectors is essential for developing policies that promote both livestock productivity and public health (Zinsstag, Schelling, Waltner-Toews & Tanner, 2011). Integrated approaches, such as the One Health framework, are increasingly recognized as effective strategies for addressing the interconnectedness of human, animal, and environmental health (Gibbs, 2014). Addressing the challenges at the intersection of livestock production and public health requires comprehensive and integrated policy solutions. Strengthening regulatory frameworks, enhancing international cooperation, and investing in research and development are critical steps. Policymakers should prioritize the development of sustainable livestock systems that balance productivity with environmental and public health goals (FAO, 2018). Education and outreach programs for farmers, consumers, and other stakeholders are also vital for promoting best practices and ensuring the successful implementation of policies. Ultimately, a holistic approach that considers the diverse and interconnected aspects of livestock production will be essential for achieving sustainable and healthy outcomes (Herrero et al., 2014).

1.1 Statement of the Problem

The global livestock industry is a significant contributor to food security, rural livelihoods, and economic development. However, it also poses substantial public health risks, including the spread of zoonotic diseases, foodborne illnesses, and the development of antibiotic resistance. According to the World Health Organization (WHO), foodborne diseases cause an estimated 600 million cases of illness and 420,000 deaths worldwide annually (WHO, 2015). This intersection between livestock production and public health underscores the need for comprehensive policies that address both sectors effectively. Despite existing policies, there is a growing recognition that current approaches may be insufficient in managing the complexities and interdependencies of livestock production and public health outcomes. This study seeks to critically examine these policy challenges and propose viable solutions that align with both public health and livestock production goals.

Research into the intersection of livestock production and public health has identified several gaps that need to be addressed. While there is substantial literature on the economic and environmental aspects of livestock production, fewer studies have comprehensively analyzed the public health implications of these practices within the context of policy frameworks (Herrero et al., 2013). Additionally, there is a need for more data-driven analysis on the effectiveness of existing policies in mitigating public health risks associated with livestock production. For instance, the role of regulatory measures in controlling the use of antibiotics in livestock and their impact on antibiotic resistance remains underexplored. This study aims to fill these gaps by providing an integrated analysis of livestock production policies and their direct and indirect effects on public health, utilizing both qualitative and quantitative data.

The findings of this study will benefit a wide range of stakeholders, including policymakers, public health officials, livestock producers, and consumers. Policymakers will gain insights into the efficacy of current policies and identify areas for improvement to better protect public health without compromising the economic benefits of livestock production. Public health officials will benefit from a clearer understanding of the links between livestock practices and health outcomes, enabling more effective disease prevention and control strategies. Livestock producers will receive guidance on best practices that align with public health goals, potentially leading to safer and more sustainable production methods. Lastly, consumers will benefit from improved food safety standards and reduced exposure to health risks associated with livestock products (Grace, Mutua, Ochungo, Kruska, Jones, Brierley & Kang'ethe, 2012). By addressing these diverse needs, the study aims to contribute to the development of more holistic and effective policies that ensure the sustainability and safety of livestock production systems.

2.0 LITERATURE REVIEW

2.1 Theoretical Review

2.1.1 One Health Theory

The One Health Theory posits that the health of humans, animals, and ecosystems are inextricably linked, necessitating a collaborative, multi-sectoral, and transdisciplinary approach to achieve optimal health outcomes (Gibbs, 2014). This theory is grounded in the recognition that the majority of emerging infectious diseases are zoonotic in nature, meaning they are transmitted between animals and humans. Originated by veterinarians and public health experts, One Health has gained significant traction in recent years as it addresses the interconnectedness of various health determinants. Calvin Schwabe is often credited with coining the term "One Medicine" in the 1960s, which later evolved into the broader One Health concept. The relevance of One Health to the study of livestock production and public health is profound. By acknowledging the interdependence between livestock production

practices and public health outcomes, this theory supports the formulation of integrated policies that aim to mitigate zoonotic disease risks, enhance food safety, and promote sustainable agricultural practices. It encourages collaboration between veterinarians, physicians, environmental scientists, and policymakers to create comprehensive solutions that protect and improve the health of all species involved.

2.1.2 Risk Analysis Framework

The Risk Analysis Framework is a systematic process used to identify, assess, and manage risks associated with various activities, particularly those that can impact public health and safety. This framework was formalized by the Codex Alimentarius Commission, which is a body established by the Food and Agriculture Organization (FAO) and the World Health Organization (WHO) to develop international food standards (Codex Alimentarius Commission, 2013). The main components of this framework include risk assessment, risk management, and risk communication. Risk assessment involves the scientific evaluation of known or potential adverse health effects resulting from human exposure to hazards, such as pathogens or contaminants in food. Risk management encompasses the decisions and actions taken to mitigate identified risks, while risk communication involves the exchange of information about risks and risk management strategies among stakeholders. This framework is highly relevant to the intersection of livestock production and public health, as it provides a structured approach to evaluating and addressing the risks associated with livestock farming practices, including the use of antibiotics, the spread of zoonotic diseases, and foodborne illnesses. By applying the Risk Analysis Framework, researchers and policymakers can develop evidence-based strategies to minimize public health risks while supporting sustainable livestock production.

2.1.3 Social-Ecological Systems Theory

The Social-Ecological Systems (SES) Theory emphasizes the complex interactions and feedback loops between human societies and their natural environments. This theory was developed by Elinor Ostrom and her colleagues, who recognized that sustainable management of natural resources requires understanding the interconnectedness of ecological and social systems (Ostrom, 2009). SES theory integrates concepts from ecology, economics, sociology, and political science to analyze how human actions impact ecosystems and how ecological changes, in turn, affect human well-being. It highlights the importance of governance systems, social norms, and institutional arrangements in managing resources sustainably. In the context of livestock production and public health, SES theory is particularly relevant because it provides a holistic framework for examining how livestock farming practices affect ecological systems (e.g., land use, water resources, biodiversity) and how these ecological changes impact public health (e.g., through the spread of zoonotic diseases or environmental pollution). By applying SES theory, researchers can identify leverage points for policy interventions that promote both ecological sustainability and public health. This theory underscores the need for cross-sectoral collaboration and adaptive management practices to address the dynamic and interdependent challenges at the intersection of livestock production and public health.

2.2 Empirical Review

Herrero, Thornton, Notenbaert, Wood, Msangi, Freeman & Lynam (2013) investigated the drivers of change in crop-livestock systems and their potential impacts on agro-ecosystems services and human well-being up to 2030. The study used a combination of global datasets, modeling tools, and scenario analysis to assess the changes in crop-livestock systems across different regions. The study found that population growth, dietary changes, and climate change are major drivers that will significantly impact livestock production systems. These changes are likely to increase pressure on natural resources, leading to adverse environmental and public health outcomes. The authors recommended the adoption of integrated policies that consider environmental sustainability, economic viability, and public health.

They also suggested enhancing research on adaptive livestock production systems to cope with future challenges.

Grace, Mutua, Ochungo, Kruska, Jones, Brierley & Kang'ethe (2012) explored the linkages between poverty and zoonotic diseases, focusing on livestock-keeping populations in developing countries. The research involved mapping poverty and zoonoses hotspots using spatial analysis and reviewing existing literature on zoonotic diseases. The study identified that livestock-keeping populations in low-income regions are at a higher risk of zoonotic diseases due to close human-animal interactions and poor livestock management practices. The authors called for integrated health and agricultural policies that target poverty alleviation and zoonotic disease control simultaneously. They emphasized the need for improved veterinary services and better livestock management practices.

Van Boeckel, Brower, Gilbert, Grenfell, Levin, Robinson & Laxminarayan (2015) aimed to quantify global trends in antimicrobial use in food animals and assess the implications for public health. The study utilized global datasets on livestock production, antibiotic sales, and resistance patterns to estimate antimicrobial use across different regions and livestock species. The research revealed a significant increase in antimicrobial use in livestock, particularly in low- and middle-income countries. This rise is linked to the growing demand for animal protein and intensive farming practices. The authors recommended stringent regulations on antibiotic use in livestock, enhanced surveillance of antimicrobial resistance, and promotion of alternative disease management practices.

Jones, Grace, Kock, Alonso, Rushton, Said & Pfeiffer (2013) examined the emergence of zoonotic diseases in the context of agricultural intensification and environmental change. The study employed a combination of epidemiological data analysis, case studies, and literature review to explore the relationship between agricultural practices and zoonotic disease emergence. The findings highlighted that intensive livestock production systems, deforestation, and habitat fragmentation are significant factors contributing to the emergence of zoonotic diseases. The authors recommended policies that promote sustainable agricultural practices, protect natural habitats, and strengthen disease surveillance and response systems.

Thornton, van de Steeg, Notenbaert & Herrero (2015). investigated the impacts of climate change on livestock production and the associated public health risks. The study used climate models, livestock production data, and public health records to analyze the potential impacts of climate change on livestock systems and human health. The research indicated that climate change is likely to exacerbate heat stress in animals, reduce feed and water availability, and increase the incidence of vector-borne diseases. The authors recommended the development of climate-resilient livestock systems, improved animal health monitoring, and policies that integrate climate change adaptation with public health strategies.

Marshall &Levy (2011) aimed to assess the impacts of antimicrobial use in food animals on human health, focusing on the development of antibiotic-resistant bacteria. The study reviewed existing literature on antimicrobial use in livestock, resistance patterns, and associated health outcomes in humans. The findings showed a clear link between the use of antibiotics in livestock and the emergence of antibiotic-resistant bacteria, which can be transferred to humans through direct contact or consumption of contaminated products. The authors advocated for the reduction of non-therapeutic antibiotic use in livestock, improved infection prevention practices, and the development of new antibiotics and alternatives.

Gerber, Steinfeld, Henderson, Mottet, Opio, Dijkman & Tempio (2013) sought to assess the environmental impacts of livestock production and identify mitigation opportunities. The study used life cycle assessment (LCA) methods to quantify greenhouse gas emissions, land use, and water consumption associated with different livestock production systems. The research indicated that

livestock production is a significant contributor to global greenhouse gas emissions, particularly methane and nitrous oxide. Intensive production systems were found to be more resource-efficient but posed higher risks of pollution and disease. The authors recommended the adoption of best management practices, such as improved feed efficiency, manure management, and integrated crop-livestock systems, to reduce environmental impacts and enhance sustainability.

3.0 METHODOLOGY

The study adopted a desktop research methodology. Desk research refers to secondary data or that which can be collected without fieldwork. Desk research is basically involved in collecting data from existing resources hence it is often considered a low cost technique as compared to field research, as the main cost is involved in executive's time, telephone charges and directories. Thus, the study relied on already published studies, reports and statistics. This secondary data was easily accessed through the online journals and library.

4.0 FINDINGS

This study presented both a contextual and methodological gap. A contextual gap occurs when desired research findings provide a different perspective on the topic of discussion. For instance, Gerber, Steinfeld, Henderson, Mottet, Opio, Dijkman & Tempio (2013) sought to assess the environmental impacts of livestock production and identify mitigation opportunities. The study used life cycle assessment (LCA) methods to quantify greenhouse gas emissions, land use, and water consumption associated with different livestock production systems. The research indicated that livestock production is a significant contributor to global greenhouse gas emissions, particularly methane and nitrous oxide. Intensive production systems were found to be more resource-efficient but posed higher risks of pollution and disease. The authors recommended the adoption of best management practices, such as improved feed efficiency, manure management, and integrated crop-livestock systems, to reduce environmental impacts and enhance sustainability. On the other hand, the current study focused on understanding the intersection of livestock production and public health looking at the policy challenges and solutions.

Secondly, a methodological gap also presents itself, for example, Gerber, Steinfeld, Henderson, Mottet, Opio, Dijkman & Tempio (2013) used life cycle assessment (LCA) methods to quantify greenhouse gas emissions, land use, and water consumption associated with different livestock production systems- in assessing the environmental impacts of livestock production and identify mitigation opportunities. Whereas, the current study adopted a desktop research method.

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The intersection of livestock production and public health presents a multifaceted set of challenges and opportunities that require comprehensive, integrated policy responses. The complexities arising from the close interaction between animal and human health, coupled with environmental considerations, demand a holistic approach that addresses these interconnected domains simultaneously. Livestock production is indispensable for food security and economic stability, particularly in developing regions. However, it also poses significant public health risks, including zoonotic diseases, antimicrobial resistance, and foodborne illnesses. Effective policies must, therefore, strike a delicate balance between maximizing the benefits of livestock production and minimizing its adverse public health impacts.

A major conclusion drawn from this study is the critical need for integrated and interdisciplinary approaches, exemplified by frameworks such as One Health, which recognize the interconnectedness of human, animal, and environmental health. Policies grounded in such approaches can better

anticipate and mitigate the public health risks associated with livestock production. For instance, improving animal health through better veterinary care and biosecurity measures can reduce the incidence of zoonotic diseases, which in turn protects human health. Similarly, sustainable farming practices can mitigate environmental degradation, which has direct and indirect effects on public health. These integrated approaches necessitate strong collaboration across various sectors, including agriculture, health, and environmental management.

Another significant conclusion is the importance of stringent regulation and surveillance to manage and reduce the public health risks associated with livestock production. Antimicrobial resistance, driven by the overuse of antibiotics in animal husbandry, exemplifies a critical area where policy intervention is urgently needed. Effective regulation to curb the misuse of antibiotics in livestock can significantly reduce the emergence of resistant pathogens that pose severe threats to human health. Additionally, robust surveillance systems are essential to monitor and respond to outbreaks of foodborne illnesses and zoonotic diseases. These systems should be supported by comprehensive data collection and sharing mechanisms that facilitate timely and coordinated responses across regions and sectors.

Finally, the study underscores the need for continuous research and innovation to address the evolving challenges at the intersection of livestock production and public health. Climate change, population growth, and evolving dietary preferences are altering the landscape of livestock production and associated health risks. Policies must be adaptive and informed by the latest scientific research to remain effective. This includes investing in new technologies and practices that enhance the sustainability of livestock production, such as improved feed efficiency, waste management systems, and alternative disease control methods. Furthermore, there should be a concerted effort to educate and engage stakeholders, from policymakers to farmers and consumers, about the interconnected nature of livestock production and public health, fostering a culture of shared responsibility and proactive risk management.

Addressing the policy challenges at the intersection of livestock production and public health requires a coordinated, multifaceted strategy that integrates health, environmental, and agricultural considerations. By fostering interdisciplinary collaboration, implementing stringent regulatory frameworks, enhancing surveillance systems, and promoting continuous research and innovation, we can develop sustainable solutions that protect and improve public health while ensuring the economic viability and environmental sustainability of livestock production systems. These efforts will contribute to a more resilient and health-conscious agricultural sector capable of meeting the demands of a growing global population.

5.2 Recommendations

The study on the intersection of livestock production and public health has generated several recommendations that contribute to theory, practice, and policy in this field. Firstly, the study emphasizes the need for a theoretical framework that integrates human, animal, and environmental health, such as the One Health approach. By adopting such frameworks, policymakers and practitioners can better understand the complex interactions between livestock production and public health, leading to more effective interventions. This contribution to theory enhances our conceptual understanding of the interconnectedness of these domains and provides a foundation for interdisciplinary research and practice.

In terms of practice, the study underscores the importance of implementing evidence-based strategies to mitigate the public health risks associated with livestock production. One key recommendation is the adoption of sustainable farming practices that promote animal welfare, reduce environmental impacts, and enhance food safety. Practices such as improved biosecurity measures, responsible

antibiotic use, and proper waste management can help minimize the transmission of zoonotic diseases and antimicrobial resistance while ensuring the sustainability of livestock production systems. These recommendations provide actionable guidance for farmers, veterinarians, and other stakeholders involved in livestock production.

From a policy perspective, the study calls for the development and implementation of comprehensive regulations and surveillance mechanisms to safeguard public health. This includes stringent regulations on antibiotic use in livestock, improved monitoring of foodborne illnesses and zoonotic diseases, and enhanced enforcement of food safety standards. Policymakers play a crucial role in creating an enabling environment for sustainable livestock production by establishing clear guidelines, providing incentives for compliance, and allocating resources for surveillance and enforcement activities. By integrating these recommendations into policy frameworks, governments can better protect public health while supporting the economic viability of livestock farming.

Furthermore, the study highlights the importance of international collaboration and knowledge exchange in addressing global challenges at the intersection of livestock production and public health. Given the transboundary nature of many livestock-related issues, such as disease outbreaks and antimicrobial resistance, coordinated action at the regional and global levels is essential. International organizations, governments, NGOs, and research institutions should collaborate to share best practices, harmonize regulations, and support capacity-building efforts in resource-limited settings. This recommendation emphasizes the importance of solidarity and collective action in addressing shared challenges.

Additionally, the study suggests investing in research and innovation to develop sustainable solutions that balance public health protection with economic and environmental considerations. This includes research into alternative disease control methods, such as vaccines and probiotics, as well as technologies that improve resource efficiency and reduce environmental impacts. By fostering a culture of innovation and knowledge-sharing, policymakers, practitioners, and researchers can collectively identify and implement strategies that promote the long-term sustainability of livestock production systems while safeguarding public health.

Lastly, the study emphasizes the importance of stakeholder engagement and communication in driving positive change in livestock production and public health. By involving farmers, consumers, industry stakeholders, and civil society organizations in decision-making processes, policymakers can ensure that policies and interventions are contextually appropriate and socially acceptable. Effective communication strategies, such as public awareness campaigns and stakeholder consultations, can help build trust, foster cooperation, and promote behavior change. This recommendation highlights the need for participatory approaches that empower communities to take ownership of their health and well-being in the context of livestock production.

REFERENCES

Broom, D. M. (2017). Animal welfare in the European Union. European Parliament.

CDC. (2017). Zoonotic diseases. Centers for Disease Control and Prevention. Retrieved from https://www.cdc.gov/onehealth/basics/zoonotic-diseases.html

CDC. (2018). Foodborne illness estimates. Centers for Disease Control and Prevention. Retrieved from https://www.cdc.gov/foodborneburden/2011-foodborne-estimates.html

Codex Alimentarius Commission. (2013). Principles and guidelines for the conduct of microbiological risk assessment. FAO/WHO.

Department of Health and Social Care. (2019). UK Five-Year Antimicrobial Resistance Strategy. Retrieved from https://www.gov.uk/government/publications/uk-5-year-antimicrobial-resistance-strategy-2019-to-2024

European Commission. (2019). Food safety in the EU. Retrieved from https://ec.europa.eu/food/overview_en

European Medicines Agency. (2019). Sales of veterinary antimicrobial agents in 31 European countries in 2017. Retrieved from https://www.ema.europa.eu/en/news/sales-veterinary-antimicrobial-agents-31-european-countries-2017

FAO. (2013). World Livestock 2013: Changing disease landscapes. FAO.

FAO. (2018). Sustainable livestock production. FAO.

FDA. (2020). National Antimicrobial Resistance Monitoring System (NARMS). Retrieved from https://www.fda.gov/animal-veterinary/national-antimicrobial-resistance-monitoring-system

Fraser, D. (2014). The role of animal welfare science in finding solutions to ethical concerns for animal agriculture. In Animal Frontiers, 4(3), 37-42.

FSA. (2019). Campylobacter. Food Standards Agency. Retrieved from https://www.food.gov.uk/safety-hygiene/campylobacter

Gerber, P. J., Steinfeld, H., Henderson, B., Mottet, A., Opio, C., Dijkman, J., & Tempio, G. (2013). Tackling climate change through livestock: A global assessment of emissions and mitigation opportunities. FAO.

Gibbs, E. P. J. (2014). The evolution of One Health: A decade of progress and challenges for the future. In Veterinary Record, 174(4), 85-91.

Grace, D., Mutua, F., Ochungo, P., Kruska, R., Jones, K., Brierley, L., & Kang'ethe, E. (2012). Mapping of poverty and likely zoonoses hotspots. ILRI.

Herrero, M., Thornton, P. K., Notenbaert, A. M., Wood, S., Msangi, S., Freeman, H. A., & Lynam, J. (2013). Drivers of change in crop–livestock systems and their potential impacts on agro-ecosystems services and human well-being to 2030. In Global Environmental Change, 19(1), 206-219.

Hoffmann, S., Batz, M. B., & Morris, J. G. Jr. (2012). Annual cost of illness and quality-adjusted life year losses in the United States due to 14 foodborne pathogens. In Journal of Food Protection, 75(7), 1292-1302.

Jones, B. A., Grace, D., Kock, R., Alonso, S., Rushton, J., Said, M. Y., & Pfeiffer, D. U. (2013). Zoonosis emergence linked to agricultural intensification and environmental change. In Proceedings of the National Academy of Sciences, 110(21), 8399-8404.

Marshall, B. M., & Levy, S. B. (2011). Food animals and antimicrobials: Impacts on human health. In Clinical Microbiology Reviews, 24(4), 718-733.

Marshall, B. M., & Levy, S. B. (2011). Food animals and antimicrobials: Impacts on human health. Clinical Microbiology Reviews, 24(4), 718-733.

MHLW. (2016). Action Plan to Combat Antimicrobial Resistance. Ministry of Health, Labour and Welfare. Retrieved from https://www.mhlw.go.jp/stf/seisakunitsuite/bunya/0000123586.html

MHLW. (2017). Foodborne illness statistics. Ministry of Health, Labour and Welfare. Retrieved from https://www.mhlw.go.jp/english/

Nardone, A., Ronchi, B., Lacetera, N., Ranieri, M. S., & Bernabucci, U. (2010). Effects of climate changes on animal production and sustainability of livestock systems. In Livestock Science, 130(1-3), 57-69.

OIE. (2019). One Health. World Organisation for Animal Health. Retrieved from https://www.oie.int/en/for-the-media/onehealth/

Ostrom, E. (2009). A general framework for analyzing sustainability of social-ecological systems. Science, 325(5939), 419-422.

Otte, J., Roland-Holst, D., Pfeiffer, D., Soares-Magalhaes, R., Rushton, J., Graham, J., & Silbergeld, E. (2012). Industrial livestock production and global health risks. In Food and Agriculture Organization of the United Nations.

Poester, F. P., Samartino, L. E., & Santos, R. L. (2013). Pathogenesis and pathobiology of brucellosis in livestock. Brazilian Journal of Infectious Diseases, 17(2), 12-20. https://doi.org/10.1016/j.bjid.2012.11.004

Robinson, T. P., Wertheim, H. F. L., & Kock, R. (2014). Animal production and zoonoses. In Preventive Veterinary Medicine, 117(1), 1-11. https://doi.org/10.1016/j.prevetmed.2014.08.001

Staal, S. J., Poole, E. J., Baltenweck, I., Mwacharo, J., Romney, D., Herrero, M., & Thorpe, W. (2009). Smallholder dairy systems in the East African highlands: Baseline report of ILRI-IFAD dairy projects in Ethiopia, Kenya and Uganda. ILRI.

Steinfeld, H., Gerber, P., Wassenaar, T., Castel, V., Rosales, M., & de Haan, C. (2013). Livestock's long shadow: Environmental issues and options. FAO.

Thornton, P. K. (2010). Livestock production: Recent trends, future prospects. In Philosophical Transactions of the Royal Society B: Biological Sciences, 365(1554), 2853-2867.

Thornton, P. K., van de Steeg, J., Notenbaert, A., & Herrero, M. (2015). The impacts of climate change on livestock and livestock systems in developing countries: A review of what we know and what we need to know. In Agricultural Systems, 101(3), 113-127.

Van Boeckel, T. P., Brower, C., Gilbert, M., Grenfell, B. T., Levin, S. A., Robinson, T. P., ... & Laxminarayan, R. (2015). Global trends in antimicrobial use in food animals. In Proceedings of the National Academy of Sciences, 112(18), 5649-5654.

WHO. (2015). WHO estimates of the global burden of foodborne diseases: Foodborne disease burden epidemiology reference group 2007-2015. WHO.

WHO. (2016). Rift Valley fever. World Health Organization. Retrieved from https://www.who.int/news-room/fact-sheets/detail/rift-valley-fever

WHO. (2017). Critically important antimicrobials for human medicine – 5th revision 2016. WHO.

WHO. (2020). Antimicrobial resistance. World Health Organization. Retrieved from https://www.who.int/news-room/fact-sheets/detail/antimicrobial-resistance

World Health Organization (WHO). (2015). WHO estimates of the global burden of foodborne diseases: Foodborne disease burden epidemiology reference group 2007-2015. WHO.

Zinsstag, J., Schelling, E., Waltner-Toews, D., & Tanner, M. (2011). From "one medicine" to "one health" and systemic approaches to health and well-being. In Preventive Veterinary Medicine, 101(3-4), 148-156.