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Leveraging data to enhance Sanitary and phytosanitary measures and compliance in Kenya: a case study

GITAU, G.K and OMONDI, G.P.

Department of Clinical Studies, Faculty of Veterinary Medicine, University of Nairobi, P.O.Box 29053-00625, Nairobi, Kenya

Corresponding author: gkgitau@uonbi.ac.ke

ABSTRACT

Sanitary and Phytosanitary Measures (SPS) are salient in ensuring consumer safety and mitigating the spread of diseases or pests through agricultural and food products. However, inconsistent data on food safety, plant, and animal health and challenges with data quality and accuracy, analysis and interpretation, bureaucracy, human capacity and financial constraints may limit compliance with local and international standards. To improve market access through targeted monitoring and surveillance, there is a need to enhance local data collection and sharing and leverage the role of both public and private entities. The paper is a review that outlines key aspects of SPS data requirements, available databases, challenges, and opportunities for improvement. The process involved an exploration of the key local and international databases including the World Trade Organization, World Organization for Animal Health, COMESA, and Intergovernmental Authority on Development. We propose programs for data collection, management, and analysis incorporating both public and private sectors, while leveraging advanced technologies like big data analytics and blockchain technology to streamline SPS data processing and decision making. We further explored the establishment of frameworks for gap analysis, data sharing, and interoperability between entities. Emphasise was placed on the importance of capacity building, technology adoption, education, awareness, research, and collaboration in the context of SPS data requirements. Finally, we assessed the compliance, and utilization as important components for regional and international agricultural and food products market access and competitiveness. These strategies when successfully implemented will enhance SPS data collection, quality, and analysis, and improve their incorporation into biosecurity frameworks for improved health, local and regional harmonization, and improved market access.

Key words: Compliance, Data, Kenya, Sanitary and Phytosanitary Measures

RÉSUMÉ

Les mesures sanitaires et phytosanitaires (SPS) sont essentielles pour assurer la sécurité des consommateurs et atténuer la propagation des maladies ou des ravageurs à travers les produits agricoles et alimentaires. Toutefois, l'absence de données cohérentes sur la sécurité alimentaire, la santé des plantes et des animaux, ainsi que les problèmes liés à la qualité et à l'exactitude des données, à leur analyse et interprétation, à la bureaucratie, à la capacité humaine et aux contraintes financières peuvent limiter la conformité aux normes locales et internationales. Pour améliorer l'accès au marché via une surveillance ciblée, il est nécessaire de renforcer la collecte et le partage de données locales et de tirer parti du rôle des entités publiques et privées. Cet article de synthèse décrit les exigences clés en matière de données SPS, les bases de données disponibles, les défis, et

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les opportunités d'amélioration. Le processus a impliqué une exploration des principales bases de données locales et internationales, notamment celles de l'Organisation mondiale du commerce, de l'Organisation mondiale de la santé animale, du COMESA, et de l'Autorité intergouvernementale pour le développement. Nous proposons des programmes de collecte, de gestion et d'analyse de données intégrant les secteurs public et privé, tout en tirant parti des technologies avancées telles que l'analyse des mégadonnées et la blockchain pour rationaliser le traitement des données SPS et la prise de décision. Nous avons également exploré la mise en place de cadres pour l'analyse des écarts, le partage des données, et l'interopérabilité entre les entités. L'accent a été mis sur l'importance du renforcement des capacités, de l'adoption de technologies, de l'éducation, de la sensibilisation, de la recherche et de la collaboration dans le contexte des exigences en matière de données SPS. Enfin, nous avons évalué la conformité et l'utilisation comme éléments clés de l'accès et de la compétitivité sur les marchés agricoles et alimentaires régionaux et internationaux. Ces stratégies, lorsqu'elles sont mises en œuvre avec succès, amélioreront la collecte, la qualité et l'analyse des données SPS, et leur intégration dans les cadres de biosécurité pour une meilleure santé, une harmonisation locale et régionale, et un meilleur accès aux marchés.

Mots clés : Conformité, Données, Kenya, Mesures sanitaires et phytosanitaires

INTRODUCTION

Sanitary and Phytosanitary (SPS) measures encompass biosecurity requirements and standards to protect a country's plant, animal, and human health, in the context of global trade by enhancing food safety standards and minimizing the spread of animal and plant diseases, pests, and contaminants. However, these measures also form a significant technical barrier to international trade, especially for developing countries (Henson and Loader, 1999; Kang and Ramizo, 2017). In Kenya, the agricultural sector plays a vital role in the economy, contributing approximately 27% of the Gross Domestic Product while employing about 40% of the national labor force (CBK, 2023). Kenya faces significant barriers to SPS standards implementation and monitoring like other developing countries due to inconsistent/incomplete data on food safety, plant and animal health; data accuracy, analysis, and interpretation; and financial and human capacity constraints and these impact market access for agricultural products (Noor, 2002; Edewa, 2016). Some of the actors in the export value chain have not fully developed or met SPS export certification standards/systems for animal and plant to enable them access high end markets in the developed world. Failure or lack of such systems means that credible data on infections/diseases/chemicals that would be required as proof of clean and risk-free animal and plant products to certify products for market are lacking. Part of the latter is due to lack of adequately trained personnel and lab facilities to undertake such processes. Countries such as Australia, Netherlands and New Zealand are leading in the use of SPS data to enhance quality and safety of products marketed into and out of their countries under The Organization for Economic Cooperation and Development (OECD) (https://www.oecd.org/en.html).

The regulatory framework encompasses multiple agencies, each responsible for the enforcement of SPS measures and in Kenya for example, it includes the Kenya Bureau of Standards (KEBS), the National Biosafety Authority (NBA), and the Agriculture and Food Authority (AFA), which merged several regulatory authorities into a single entity for operational and regulatory efficiency (Kang'ethe *et al*., 2020). KEBS in Kenya, or the equivalent Institutions in other Developing Countries, is the principal regulatory body charged with the

responsibility of establishing products, processes, and measurement standards, for both local and international trade. In conjunction with other relevant ministries, and directorates such as the Plant Health Inspectorate Service (KEPHIS), KEBS serves to ensure regulatory conformation in the plant health sector. The Directorate of Veterinary Services is the lead Agency in Kenya charged with the surveillance and control of animal-related diseases and products, with substantial challenges in its mandate despite significant policy progresses (Edewa, 2016; Gathura *et al*., 2020; Kang'ethe *et al*., 2020). Additional laws and statutes have been enacted in alignment with international and regional regulations to enhance its capacity to meet these SPS standards though significant challenges in compliance and enforcement persist leading to agricultural product rejections in international markets (Ngucuga, 2005; Oloo, 2010; Poulton and Kanyinga, 2014).

The key challenge in Kenya and other Developing Countries is the SPS-associated data ecosystem, a crucial component for the effective implementation and enforcement of SPS measures, as it aids in monitoring plant and animal health, food safety, pests, and contaminants (Akshatha and Dhulipala, 2023). However, despite the progress, the utilization of these data systems is hampered by inadequate technological infrastructure, lack of coordination and capacity among stakeholders, and inadequate information sharing (Theyse, 2009; Day, 2013). Thus, the ongoing efforts to harmonize SPS measures and foster international collaborations, including integration with multistakeholder networks e.g., GLOBALGAP (https://www.globalgap.org/), adoption of AI-driven platforms and implementation of farm-to-fork traceability measures will be pivotal in enhancing compliance, providing evidence for prioritization of SPS investments, and expanding access to international markets. This paper explores the sanitary and phytosanitary data ecosystem and its challenges in Kenya and other Developing Countries, and elucidate on the opportunities for future investment to ensure compliance and facilitate market access for agricultural commodities and food products.

Data Ecosystem for Sanitary and Phytosanitary Measures. The effective implementation of SPS measures necessitates an ecosystem including the collection, analysis, interpretation, and management of specific data (Figure 1) that can ensure evidence-based decisions and compliance with safety standards to ensure human, animal, and plant health, quality compliance, and facilitate market access. These data ecosystem encompass plant health (pest and disease status, phytosanitary inspections, and effectiveness of pest management strategies); animal health (data on disease outbreaks, vaccinations, and biosecurity measures); food safety (data on food processing, chemical, and microbiological quality, handling, and storage); product data (type, origin, and traceability); chemical usage data (type and dosage, and data on residues); and, compliance and enforcement data (compliance rates, trends, and performance indicators). The data ecosystem ideally should include effective data collection strategies necessary for enhancing the capacity to meet SPS requirements.In Kenya for example, several international, and governmental institutions and organizations are responsible for development, monitoring and ensuring compliance with SPS measures, including, the Kenya Plant Health Inspectorate Service, Agriculture and Livestock Research Organization, the Department of Veterinary Services, the Ministry of Agriculture, Livestock, and Fisheries, the Ministry of Trade and Investments, and various private sector actors, including exporters and producer associations, industry associations, and private laboratories, and international/regional organizations including World Health Organization,

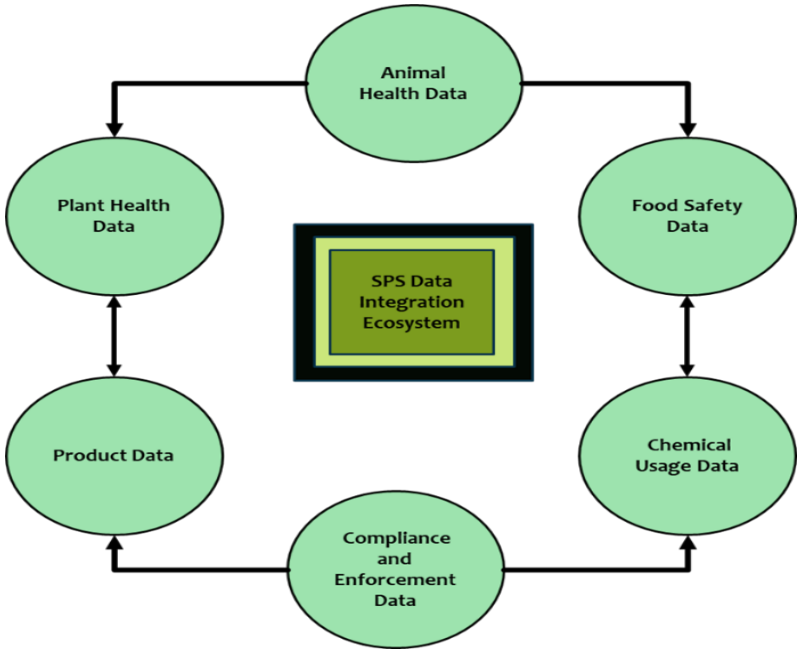

Figure 1. Data ecosystem for sanitary and phytosanitary measures in Kenya

World Trade Organization, East African Community, Intergovernmental Authority on Development , African Union, Food and Agriculture Organization, International Plant Protection Union, and Common Market for Eastern and Southern Africa (COMESA) (Figure 2). Although significant investments have been made in Kenya's SPS monitoring and compliance arena, its integration with the private sector and international frameworks is inadequate and its operationalization continues to be hampered by a lack of prioritization in the national trade and development agenda, thus impeding agricultural exports (Noor, 2002; Ouma, 2010; Edewa, 2016; Kang and Ramizo, 2017). Thus, although Kenya, like other East African states, has benefited from the development of SPS instruments through evaluations such as the Phytosanitary Capacity Evaluations, and the East African SPS Protocol development to harmonize regulations and procedures across the region, most of these government and other organizations and/or institutions in Kenya operate in silos, with data collection systems often being fragmented, and inconsistent, and data quality varying across agencies hindering its effective analysis, harmonization, interpretation, and implementation to meet international standards (Edewa, 2016;Gathura *et al*., 2020; Kang'ethe *et al*., 2020).

Challenges and constraints in accessibility and utilization of SPS databases. Despite existing data frameworks, challenges and constraints remain in data collection, analysis, harmonization, and effective utilization of SPS related data across various platforms, institutions and organizations in Kenya (Noor, 2002; Ngucuga, 2005;Day, 2013; Edewa, 2016;Kang and Ramizo, 2017). These include: a) Data quality and managements systems: Incomplete, inconsistency and inadequacy in data collection methodologies, organization and management hampers data accuracy, transparency, validation, quality, interpretation, and harmonization.

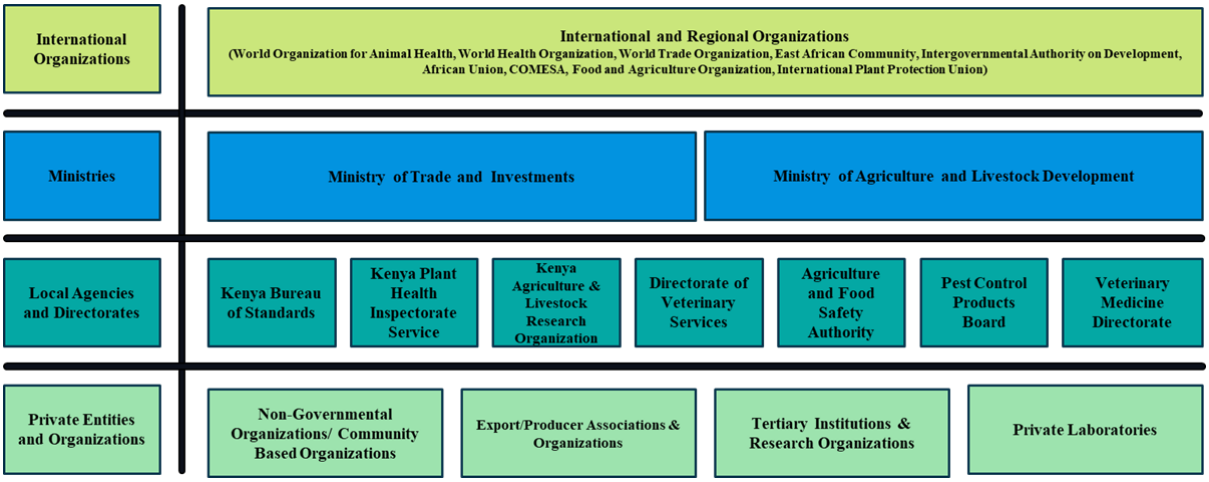

Figure 2. Databases/Institutions responsible for SPS measures and regulations in Kenya

b) Inadequacies on technological infrastructure: A key challenge in the implementation of SPS measures in Kenya is inadequate technological infrastructure and application of innovative technologies. The latter prevents smallholder farmers and those in marginalized environments from harnessing and benefitting from advancements in technology. c) Data fragmentation: Due to multiplicity of stakeholders responsible for SPS monitoring and implementation, data collected are often siloed resulting to limited data sharing, accessibility, and effectiveness in developing policies and decision making. These coupled with poor inter-agency coordination, administrative and institutional bottlenecks, and a lack of clear policy for the role of private organizations and research institutions limit data collection, utilization, and timely response. d) Financial and human capacity constraints: Limited financial resources, and shortage of trained/technical staff lead to poor data collection, management, analysis, and interpretation, and this hinders effective implementation of SPS measures. e) Legal and policy insufficiencies: Legal and policy gaps hamper harmonization of regulatory frameworks across the region and internationally. Additionally, legal and policy gaps on data accessibility and sharing, intellectual property rights and privacy concerns hinder multi-institutional data sharing and harmonization of data. Existing legal loopholes lead to inadequate linkages between government and the private sector/non-governmental organizations, and lack of conformity to regional and international frameworks leading to product rejections. f) Inadequate surveillance systems: Kenya has traditionally had a weak livestock, pest, contaminants and chemical surveillance system due to insufficient real-time monitoring, financial and technical expertise, and laboratory facilities. Further, the lack of farm-to-fork traceability of agricultural products limits safety assessments, disempowers consumers, and hinders the adoption of sustainable practices. Nevertheless, Kenya has made significant investments in SPS monitoring and compliance despite various challenges, and developed collaborations among government agencies, some private sector players, and continues to play a leading role in regional and international economic blocks (East African Community, COMESA, African Union, NEPAD, European Union-Kenya Economic Partnership). Kenya continues to address these challenges specifically SPS databases, to ensure that they are effectively utilized to enhance compliance with international standards (Henson and Loader, 1999; Jaffee, 2006; Henson, 2007;

Day *et al*., 2012; Day, 2013; Kareem, 2014; Njua, 2017; Molnar and Godefroy, 2020).

Opportunities for enhancing Sanitary and Phytosanitary Databases and their utilization. Although the overall message in this paper is that "much remains to be done," in the SPS sphere in Kenya and other Developing Countries, especially in gaining and/or maintaining access to high-value markets for agricultural products in tandem with increased SPS compliance, there are many opportunities to improve the SPS. The areas to be addressed include adoption and acceleration of technology and innovations, data collection and monitoring, human capacity development, research and development, education, and improving harmonization and coordination among stakeholders to streamline compliance efforts and reduce costs and duplication of roles (Noor, 2002; Ngucuga, 2005; Henson, 2007; Day, 2013; Edewa, 2016; Kang and Ramizo, 2017). Key among these opportunities for future enhancement of SPS databases and data utilization include: a) Leveraging technological infrastructure and tools: The adoption of digital technologies (e.g., traceability and value chain assessments, remote pest and disease sensing, conformity assessment programs) has the potential to create efficiencies in SPS systems, such as risk assessments and verification of compliance, and enhance trade in agricultural products and foods, and reduce associated costs (Theyse, 2009; Ryan *et al*., 2023). Further, adoption of technological innovations such as Blockchain can enhance supply chain traceability thus enhancing SPS measures and compliance, facilitate trade inter-linkages between different regional and international economic blocks with varying SPS requirements, and optimize local policies (Mihajlov and Kikerkova, 2019; de Souza Meireles and Pereira, 2023; Tyagi, 2023). These coupled with improvement in computing hardware, and connectivity, including incorporation of mobile-based platforms and cloud computing has the potential to enhance SPS standards, especially in smallholder farms and in rural areas through provision of real-time data, and facilitating access to guidelines and certification process, thus, improving accessibility and efficiency (Pandey *et al*., 2023; Vedantam *et al*., 2024). Additionally, advances in technology, especially big data analytics can significantly streamline data collection, processing of large volumes of data from diverse sources, and provide meaningful insights in the SPS realm, particularly, real-time surveillance, animal health data, identification of patterns, monitoring agricultural health, and prediction of disease, pest, and invasive species (Martínez-López *et al*., 2009; Lindgren, 2012;Dórea and Escobar and Craft, 2016; Vial, 2016; VanderWaal *et al*., 2017; Du, 2020; Omondi *at el*., 2021). These could be integrated into already existing platforms such as Kenya Agricultural Observatory Platform (https://www.kaop.co.ke/) and Open Data Platform (https://statistics.kilimo.go.ke/en/) thus providing a more effective approach to respond to emerging threats through targeted interventions and streamlining the decision-making process. b) Building Interoperability and Data Sharing Frameworks: As part of streamlining coordination, data sharing and decision making among SPS stakeholders, there is a need to prioritize the establishment of frameworks for data interoperability between government, private sector players, non-governmental organizations, and international organizations. This can be achieved through various mechanisms such as Public-Private Partnerships (on-the-ground data access), and Regional Data Sharing, through developing agreements with regional blocks, and organizations e.g., COMESA, East African Community and IGAD to facilitate efficient regional surveillance and response. These have been key in enhancing regional integration and streamlining cross-border SPS standards (ESCAP and ECE, 2015; Stokes, 2017; EFSA *et al*., 2019;Moysiadis *et al*., 2023).c) Capacity

Building: Investing in human resource technical capacity, especially in areas such as data analytics, surveillance, and biosecurity is key for improving the quality of SPS data collection, analysis, and interpretation. Further, investing in laboratory, diagnostic tools, computing software and hardware, and data management systems is critical in enhancing the quality of SPS data. Additionally, it is important to extend capacity building initiatives to other actors in the value chain such as the farmers, export/producer associations and local agrifoods supply networks, where SPS compliance and adoption of technological innovations is highly desired (Jaffee, 2006; Henson, 2007; Day *et al*., 2012; Day, 2013). d) Research and collaboration: There is need to enhance research capacity in local universities and research institutions, government agencies and directorates in generating data for evidence-based SPS standards policy development and enhancement. The data would be used in SPS policy development, surveillance and monitoring of pests, diseases, and contaminants, forecasting tools, and technological development. The initiatives enhance quality of data, and allow for data-driven compliance regulations, and ultimately a reduction in SPS associated costs, increase in compliance, enhancing adoption of sustainable farming practices, and improvement of livelihoods (Beghin and Bureau, 2001; Day *et al*., 2012; Day, 2013).

CONCLUSION

This paper explores data availability and challenges around sanitary and phytosanitary standards in Kenya and other Developing Countries with a specific aim of identifying areas through which data can be leveraged to enhance compliance and facilitate access to higher value markets. We recommend that improving the quality, consistency and accessibility of SPS related data in Kenya and other Developing Countries will have the potential to enhance animal and plant health, and the competitive advantage of the Countries agri-food products in regional and international markets. We specifically identify four key areas that could be used to enhance the use of data in increasing compliance with SPS measures, and overall competitiveness of agricultural and food products in the international markets. These include leveraging technological infrastructure and tools; building interoperability and data sharing frameworks through reforming the policy, legal and institutional constructs to allow government, private sector players, non-governmental organizations, and international organizations effectively share data; human resource and infrastructure capacity building; and, augmenting research and development capacities of universities, research and government institutions in key SPS areas. By addressing the existing gaps and leveraging both local and international resources such as public-private partnerships and regional economic blocks, and adopting new technologies, Kenya and other Developing Countries can enhance their SPS data collection and analysis, ultimately improving animal, plant and public health, and access to international markets.

DECLARATION OF CONFLICT OF INTEREST

The Authors declare No Conflict of Interest in this paper.

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