



ZoNoHSync

a collective journey to prevent anthrax
in Kakamega County, Kenya

May 2025

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c. Table acronyms

ACRONYM	DETAILS
COHU	County One Health Unit
ZDU	Zoonotic Disease Unit
AMREF	African Medical and Research Foundation
ILRI-ZED	International Livestock Research Institute – Zoonotic and Emerging Diseases
MoU	Memorandum of Understanding
OHHLEP	One Health High-Level Expert Panel
FAO	Food and Agriculture Organization of the United Nations
UNEP	United Nations Environment Programme
WHO	World Health Organization
WOAH	World Organisation for Animal Health
eIDSR	electronic Integrated Disease Surveillance and Response
DALYs	Disability-adjusted life years
CLD	Causal loop diagram
IFRC	International Federation of Red Cross and Red Crescent Societies
UBJ	USAID Boresha Jamii
DVS	Directorate of Veterinary Services
KWS	Kenya Wildlife Service
CIDP	County Integrated Development Plan
ToR	Terms of Reference
ToA	Theory of Action
NGOs	Non-Governmental Organisations
MSP	Multi-stakeholder Partnerships
DLA	Dynamic Learning Agenda
SWOT	Strengths, Weaknesses, Opportunities, And Threats
COM-B	Capability, Opportunity, Motivation - Behavior
CEC	County Executive Committee

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2. Executive Summary

Zoonotic diseases continue to pose a significant burden on societies. The ZoNoH project supported the implementation of the Kenyan One Health strategy by contributing to the establishment of Kakamega's County One Health Unit (COHU) and the launch of its One Health Strategic Plan 2024–2029. To aid COHU in this endeavor, ZoNoH introduced ZoNoHSync, a service integrating multiple scientific concepts (One Health, Food Systems, Capability, Opportunity, Motivation - Behavior (COM-B) model) into a practical solution that fosters concerted, context-specific actions to prevent zoonotic diseases and mitigate their impacts on the food system.

The initial phase of ZoNoHSync enabled COHU to prioritize anthrax as the zoonotic disease requiring the most urgent preventive measures. This shared decision was informed by community assessments, individual COHU members priorities, and a potential impact prioritization exercise. Subsequently, a qualitative and quantitative quick scan was conducted to assess the impacts of anthrax on Kakamega's food system. This allowed COHU to define a specific objective: reducing livestock mortality and morbidity from anthrax at the farm level in Ikolomani sub-county.

To achieve this objective, root causes and potential leverage points were identified. The three key leverage points identified were: 1) enhancing farmer knowledge and community engagement, 2) strengthening disease surveillance through policy development, and 3) increasing stakeholder engagement. A stakeholder mapping exercise identified three organizations actively involved in anthrax management in Kakamega—International Federation of Red Cross and Red Crescent Societies, the Chair Farmers Association, and UBJ—who subsequently joined COHU in the co-creation of solutions using the leverage points identified.

This collaborative effort resulted in the development and refinement of a Theory of Action (ToA) with a shared vision, supported by a qualitative feasibility study facilitated by the ZoNoH team. ZoNoHSync enabled the creation of a co-owned solution by COHU and key stakeholders in anthrax management. Beyond delivering this tangible outcome, the participatory methods adopted throughout the process fostered the establishment of a multi-stakeholder partnership united by a common ambition: a better coordination of anthrax management in Kakamega. This sets the stage for a fruitful collaboration. An upcoming launch event will seek to align this ambition with potential private and public investors and partners.

3. Introduction

a. Zoonotic diseases – a growing societal burden

ZoNoH is pioneering a One Health initiative aimed at addressing the escalating risks of zoonotic diseases, particularly prevalent in low- and middle-income countries like Kenya. The agriculture sector contributes approximately 21.3% to Kenya's nominal gross domestic product and employs over 40% of the total population. The burden of zoonotic diseases in Kenya is estimated to cause a loss of Kshs 618 billion annually according to the Ministry of Health Kenya, attributed to Brucellosis, Bovine tuberculosis and non-typhoidal Salmonella. Recurrent outbreaks of Rift Valley Fever and Anthrax have caused significant socioeconomic impacts and threatened rare and endangered wildlife species. Responses to zoonosis are often reactive rather than proactive. Authorities and stakeholders struggle to effectively manage existing zoonotic diseases in a coordinated manner, emphasizing the need for holistic and integrated solutions to prevent and control zoonoses. ZoNoH represents a proactive response to the urgent need for coordinated action in preventing zoonotic diseases and averting future pandemics. By combining the principles of One Health and Food System approaches, ZoNoH offers a comprehensive and practical solution to the complex challenges posed by zoonoses in Kenya's food system (Figure 1). Through collaborative efforts and evidence-based interventions, ZoNoH aims to empower decision-makers, strengthen community resilience, and build a healthier, more sustainable future for all.

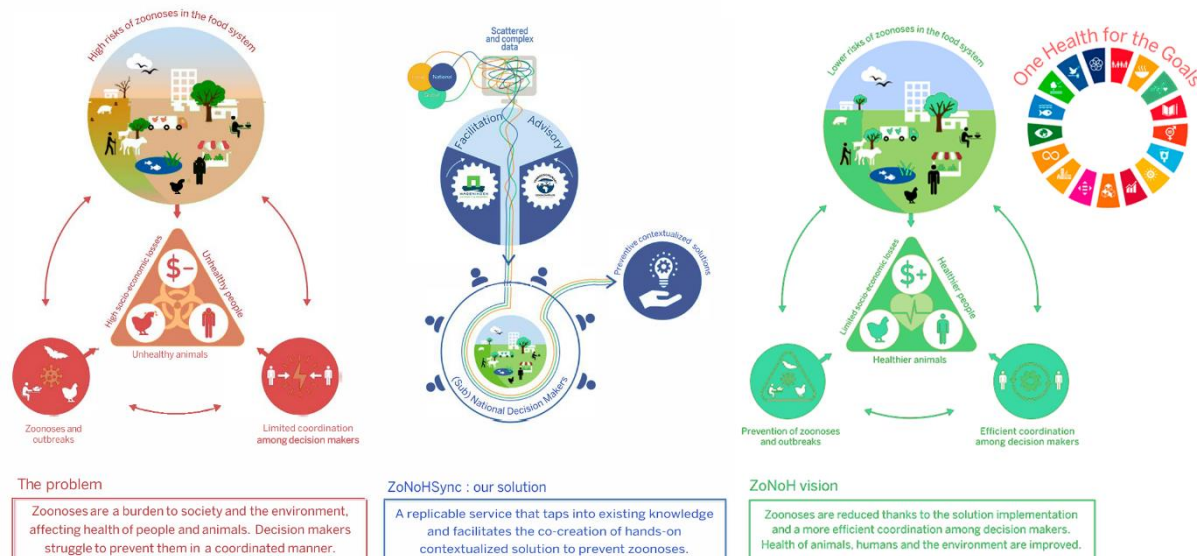


Figure 1 Example of the risks of zoonoses, and the proposed ZoNoH solution

b. Kenya: a pioneering country in One Health

Zoonoses prevalence in Kenya is high and is predicted to keep rising; zoonotic diseases pose a threat to human, animal & environmental health, reduce productivity, impose a high socioeconomic burden, and negatively impact on national development milestones. The Covid-19 crisis was a signal to government and other stakeholders to prioritise prevention and control of zoonoses and efficiently organise resources to respond to the next pandemic. The ZoNoH project sought engagement with One Health collaborative units at county level i.e. County One Health Units (COHUs) to strengthen their capacity to identify and manage zoonoses in their food systems. The Zoonotic Disease Unit (ZDU) proposed Kakamega County (Figure 2Error! Reference source not found.) as a suitable pilot location for two reasons: i) data indicating that the county is a hotspot for zoonotic diseases, specifically anthrax, and ii) local political commitment to address zoonotic diseases within the region.



Figure 2 Map of Kenya (source GISGeography)

4. Creation of the COHU

In a workshop held from 6-10 May 2024, ZoNoH supported the establishment of a functional COHU in Kakamega County, in collaboration with the County Government of Kakamega, the ZDU, and our ZoNoH partners - African Medical and Research Foundation (AMREF), International Livestock Research Institute – Zoonotic and Emerging Diseases (ILRI-ZED) (Figure 3). This COHU aims to enhance detection, preparedness, and response to emerging infectious zoonotic diseases at the human-animal-environmental interface. This initiative aligns with the [National Bridging Workshop roadmap for Kenya](#), which focuses on strengthening multi-sectoral coordination, communication, and collaboration at the sub-national level. Kakamega became the 14th COHU, contributing to the goal of the [National Strategic Plan \(2021-2025\)](#) to establish a functioning COHU in each of the 47 counties in Kenya. The ZDU and ZoNoH provided logistical and technical support during the workshop, offering training on One Health. The key outputs from the training workshop included:

- Formation of the COHU Technical Working Group comprised of 3 Directors (Health, Veterinary, and Environment) focusing on the coordination of the COHU activities;
- Draft Governance structure & draft Terms of Reference (ToR) for Kakamega COHU;
- Draft Kakamega COHU strategic plan.



Figure 3 Participants during the Kakamega COHU creation training workshop

On 7th June 2024, ZoNoH further supported Kakamega COHU in finalizing the draft COHU strategic plan and organised a High-Level Sensitization meeting on One Health on 9th October 2024, bringing together the County Executive Committees (CECs), Chief Officers and Directors as highlighted on the County's [Facebook Page](#) (Figure 4). The meeting produced five key recommendations, outlined in [this report](#), to guide ongoing collaboration in operationalizing the Kakamega COHU. The key recommendations were:

- (1) Establish and Operationalize the COHU;
- (2) Allocate Budgets and Ensure Sustainability;
- (3) Foster Cross-Sector Collaboration;
- (4) Enhance Data Collection and Research; and
- (5) Ratify the Memorandum of Understanding (MoU) and Implement the One Health Strategy.

Ultimately, on 4th December 2024, the County Government of Kakamega officially launched its One Health Strategic Plan 2024–2029 and signed an interdepartmental MoU. This event was also highlighted on the [County's Facebook Page](#) and covered by [The Star newspaper](#) which reaches an estimated 100,000 readers daily.



Figure 4 Participants (ZoNoH, partners and County representatives) during the launch of the Kakamega One Health strategic plan 2024-2029 and signing of the Interdepartmental One Health MoU signing, Kisumu, Kenya

5. ZoNoHSync

Thanks to the establishment of the COHU, the various participants could engage in piloting the ZoNoHSync service. ZoNoHSync leverages applied science for public good, through several scientific concepts, which are introduced below: One Health, Food Systems & the COM-B model.

a. One Health is both an approach and an outcome

The One Health definition (Figure 5) developed by the One Health High-Level Expert Panel (OHHLEP)¹ states:

“One Health is an integrated, unifying approach that aims to sustainably balance and optimize the health of humans, animals, plants and ecosystems. It recognizes the health of humans, domestic and wild animals, plants and the wider environment (including ecosystems) are closely linked and interdependent.

The approach mobilizes multiple sectors, disciplines and communities at varying levels of society to work together to foster well-being and tackle threats to health and ecosystems, while addressing the collective need for clean water, energy and air, safe and nutritious food, taking action on climate change, and contributing to sustainable development.”

Multilateral organisations increasingly recognise the need to work hand in hand to tackle our most pressing health challenges. One Health is seen as an essential approach for tackling complex health challenges facing our society by international organisations. Four main UN agencies joined forces in 2022 and established The Quadripartite (Q4). It aims to achieve together what no one sector can achieve alone, and it consists of: the Food and Agriculture Organization of the United Nations (FAO), United Nations Environment Programme (UNEP), World Health Organization (WHO) and World Organisation for Animal Health (WOAH). Together they developed the [One Health Joint Plan of Action \(2022 - 2026\)](#) which gives an overview of the crucial action needed to advance a shared One Health worldwide.

¹ OHHLEP is also an independent advisory group to the Quadripartite partnership of WHO, FAO, WOAH (formerly OIE) and UNEP

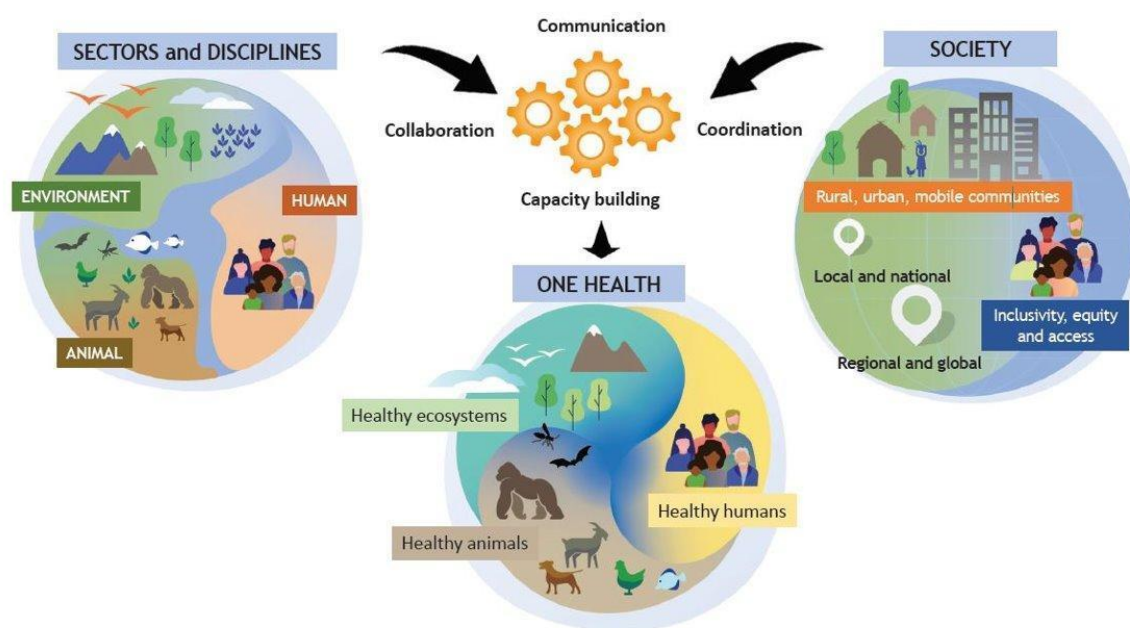


Figure 5 One Health as conceptualised by the OHHLEP (One Health Joint Plan of Action, 2022–2026)

b. Food Systems Approach

The Food Systems Approach comprehensively understands the interconnectedness of processes such as the production of food, its processing, distribution, preparation, and consumption, and studies them within their socio-economic and environmental context [Ingram 2025; Borman et al. 2022]. FSA is increasingly used to assess and shape policies and interventions aimed at promoting sustainability. This study confidently acknowledges the interdependence of three primary outcomes of food systems: socio-economic, food and nutrition security, and environmental outcomes. The FSA, however, does not adequately represent health, rather it mostly covers the nutritional aspect of health (Arredondo-Rivera et al. 2024).

c. COM-B model

The COM-B model was developed by Michie et al. (2011) via a systematic literature review of 19 behaviour change frameworks (Figure 6). The model can be used to understand behaviour and to identify behaviour targets during intervention design. In the COM-B behaviour system, increased capability and opportunity lead to increased motivation which has a direct link to behaviour. Additionally, altering one's capability or opportunity can also directly influence behaviour.

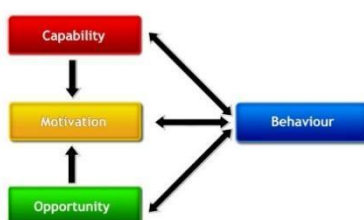


Figure 6 The COM-B behaviour system (Michie et al. 2011)

In the COM-B behaviour system, **Capability** refers to whether we have the necessary knowledge, skills, and abilities to engage in a specific behaviour. It includes two dimensions: physical (having the required knowledge and skills to perform the behaviour) and psychological (an individual's comprehension and reasoning skills needed to perform the behaviour). **Opportunity** pertains to the external factors that enable the execution of a particular behaviour. It is divided into two components: physical opportunity (opportunities provided by the environment, such as time,

location, and resources) and social opportunity (opportunities arising from social factors, such as cultural norms and social cues). **Motivation** describes the internal processes that influence our decision-making and behaviours. Its two components are reflective motivation (thoughtful processes like planning and evaluating past actions) and automatic motivation (automatic processes such as desires, impulses, and inhibitions).

The ZoNoH project seeks to address these gaps by employing a holistic approach grounded in the Capability, Opportunity, Motivation-Behavior (COM-B) model (Figure 7). We hypothesize that by enhancing the capability, opportunity, and motivation of local decision-makers, they can effectively leverage the benefits of One Health to manage zoonoses within their food systems.



Figure 7 ZoNoHSync behavior change framework

d. How ZoNoHSync articulates these concepts

ZoNoHSync was designed by an interdisciplinary team, through an iterative process as a hands-on, replicable service, to enhance the capability, opportunity, and motivation of the COHU to better manage zoonoses in their food system (Figure 8). The service focuses on three specific objectives: i) fostering One Health and Food Systems operationalization, ii) making existing data on the impact of zoonoses on local food systems available to COHU members at global, national, and local levels, and iii) supporting the co-creation of contextualized zoonoses management strategies.

The replicable service comprises a **scoping step**, where COHU members prioritize a zoonotic challenge; an **analytical step**, where the impacts of the selected challenge are explored using an original integrated food system and One Health lens; and a **co-creation step**, where visioning exercises and concrete pathways for change are developed. To ensure broad ownership and maximize resource availability, relevant food system stakeholders are invited to join COHU members in this process. Meanwhile, activities aimed at promoting their motivation to jointly adopt One Health approaches are envisioned.

Ultimately, by fostering a more inclusive and coordinated response to concrete One Health challenges, ZoNoHSync aims to support local One Health governance organizations and will facilitate connections with potential investors to ensure that COHUs have the opportunity to **launch** and implement their co-created solutions. This initiative positions Kenya as a pioneer and opens new perspectives for operationalizing One Health in the food system, benefiting humans, animals, and the environment.

A paper has been published to validate the scientific foundation of ZoNoHSync (Arredondo-Rivera et al. 2024), in addition, ZoNoHSync has been presented to several scientific conferences, further adding to its scientific credibility

(Paradigm shifts for Global One Health, 23-25 April 2024; 8th Global One Health Congress Cape Town, 20-23 September 2024).

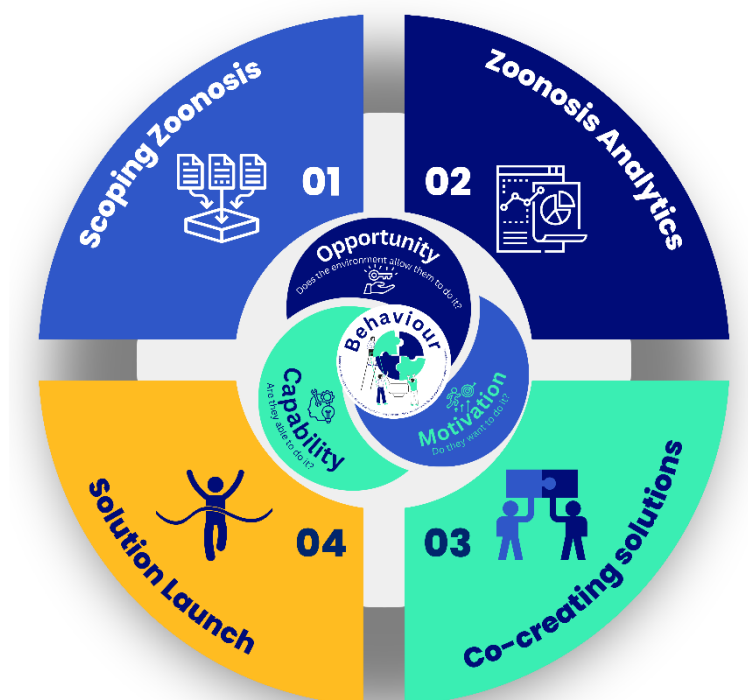


Figure 8 ZoNoHSync wheel

6. Scoping the Zoonosis

This first step in ZoNoHSync aims to deepen the COHUs understanding of local dynamics between food systems and zoonotic diseases. More specifically, the objectives were to:

- Foster shared knowledge among COHU participants about county-specific food systems and the prevalence of zoonotic diseases.
- Identify a priority zoonotic disease for the COHU to address.

To meet these objectives the ZoNoHSync team facilitated several steps, introduced below with their results.

a. Profiles and infographics of priority zoonotic diseases

To ensure a basic common knowledge of the most pressing zoonotic diseases in Kenya among the ZoNoHSync participants, five infographics on zoonotic diseases were developed. The zoonotic diseases that were chosen to profile and develop infographics for were pulled from the list of priority zoonoses in Kenya as specified by ZDU.

Pre-existing disease profiles developed by the ILRI-ZED and ZDU were recycled for this purpose and revised. Data was organized for each disease to create a profile covering the description, transmission characteristics in animals and humans, symptoms in animals and humans, diagnostic methods, prevention and control methods and a call to action for the public.

To streamline the information and create a 1-page infographic to share, the most important facts regarding the diseases were selected from the profiles in consultation with the ZoNoHSync team and developed into a unique and engaging infographic format for each disease. They can be found at zonoh.org.

b. Voice of the community

A community survey was conducted among 503 residents of Kakamega County (68% male; 32% female), capturing a broad cross-section of the population. Community members were interviewed in person by students belonging to One Health clubs, across 11 of 12 sub-counties of Kakamega, and responses were uploaded to the KoBoToolbox platform. The survey aimed to capture general awareness of zoonotic diseases, as well as personal experiences and impacts on local livelihoods.

Key findings from the community survey indicate rabies was the most prioritized zoonotic disease (35.39%), followed by anthrax (34.89%) and brucellosis (15.9%). Rabies was reported as the most frequently observed zoonotic disease (77.34%), with anthrax (49.7%) and brucellosis (37.18%) also noted. Impacts of zoonotic diseases included health issues (62.62%), income loss (40.36%) from livestock and agricultural productivity declines, increased healthcare costs (38.17%), and stress and anxiety (39.36%) due to fear of disease outbreaks.

c. COHU members prioritize zoonotic diseases in their county

The COHU survey was directed at professionals involved in zoonotic disease management in Kakamega County. It included veterinary officers, county health officers, wildlife service officials, and public health officers. Structured questionnaires were deployed digitally via KoBoToolbox, and 16 participants whose experience ranged between 4 to 33 years responded based on their roles in Kakamega County's One Health initiative and zoonotic disease prevention programs.

Key findings from the COHU survey highlighted anthrax as the most significant zoonotic disease, identified by 81.25% of respondents, with 75% reporting outbreaks in the last 20 years causing over 5% reductions in animal productivity and impacting household income and food security. Rabies ranked second (68.75%) with outbreaks confirmed by 50% of respondents, while brucellosis ranked third (56.25%) with less frequent outbreaks reported by 37.5%. Experts emphasized the substantial economic impact of zoonoses, particularly anthrax, on livestock productivity and livelihoods.

d. Ranking zoonoses based on societal perspective

A prioritization process was carried out according to the national One Health zoonotic disease prioritization tool criteria (Munyua et al., 2016), to determine the zoonotic diseases of greatest concern in Kakamega County. The criteria used to evaluate and rank the diseases included severity of illness in humans, epidemic potential, socio-economic impact, prevalence/incidence, and potential for intervention. The diseases were then ranked, and their scores normalized to reflect their relative importance.

The prioritization process ranked anthrax as the most pressing disease due to its severity, economic impact, and intervention potential, with 75% of professionals highlighting frequent outbreaks. Rabies was ranked second for its severity and intervention potential, though with lower economic impact. Brucellosis, ranked third, showing lower severity but higher prevalence, impacting livestock productivity and the economy. Echinococcosis was ranked lowest with limited presence and minimal economic or health impact reported by stakeholders.

e. Rich picture

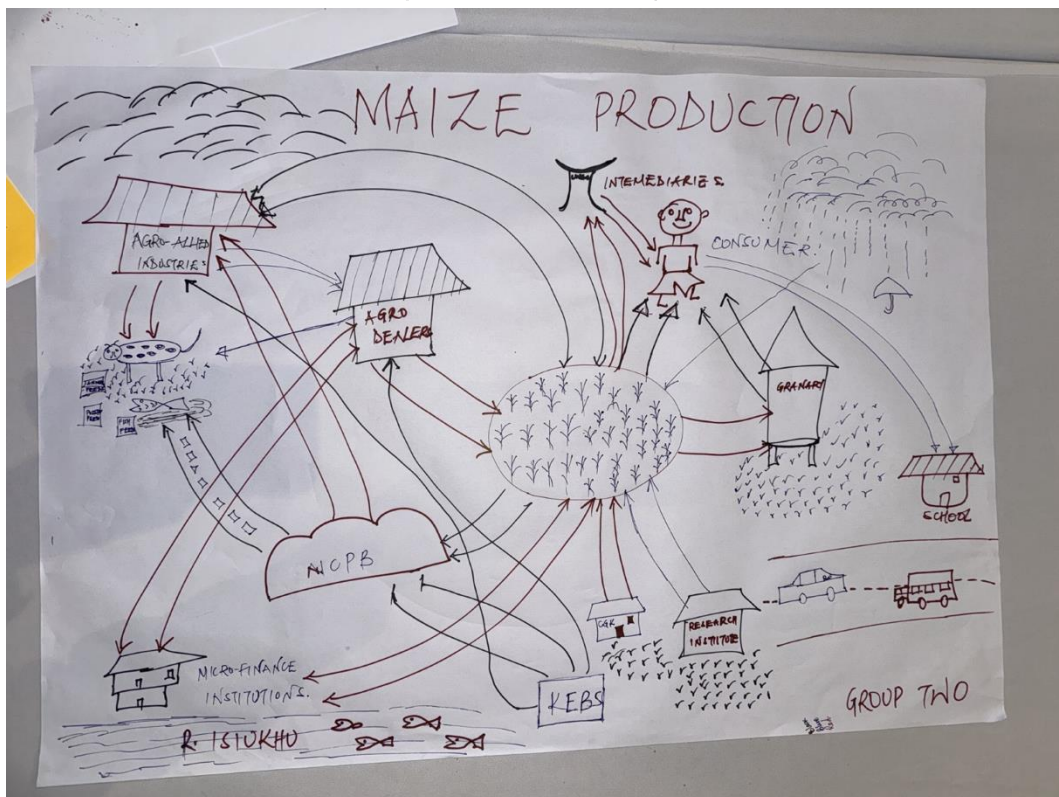
A rich picture tool fosters the creation of a shared understanding in a group through the use of pictures, diagrams, and symbols to explore a situation to understand the contributing factors, how they interact with each other, and the outcomes. The Kakamega COHU attendees were divided into four groups and asked to develop a rich picture of the food systems in the county.

One group developed a rich picture of a poultry system, the second group produced a maize production system, the third and fourth created dairy and beef production systems respectively. During plenary presentations the four groups were able to identify: the key components, stakeholders, zoonotic disease occurrence & transmission, processes & practices influencing zoonoses, drivers of disease outcomes, impacts, and intervention points.

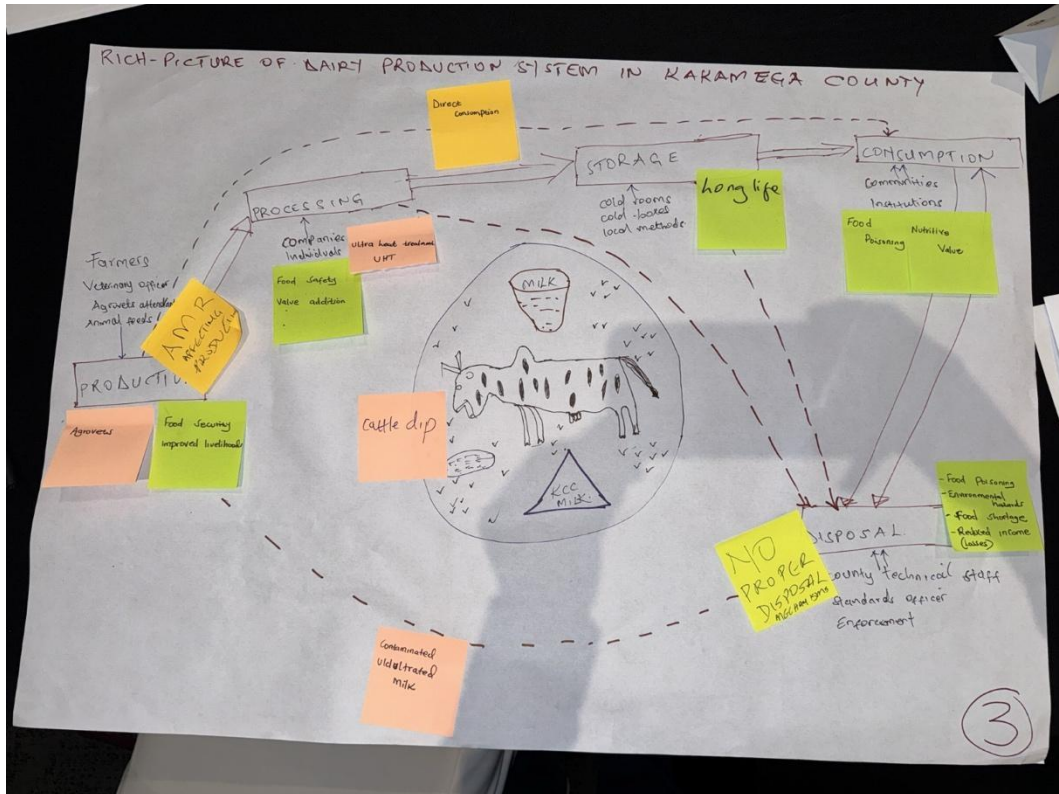
Group 1: Poultry Production System



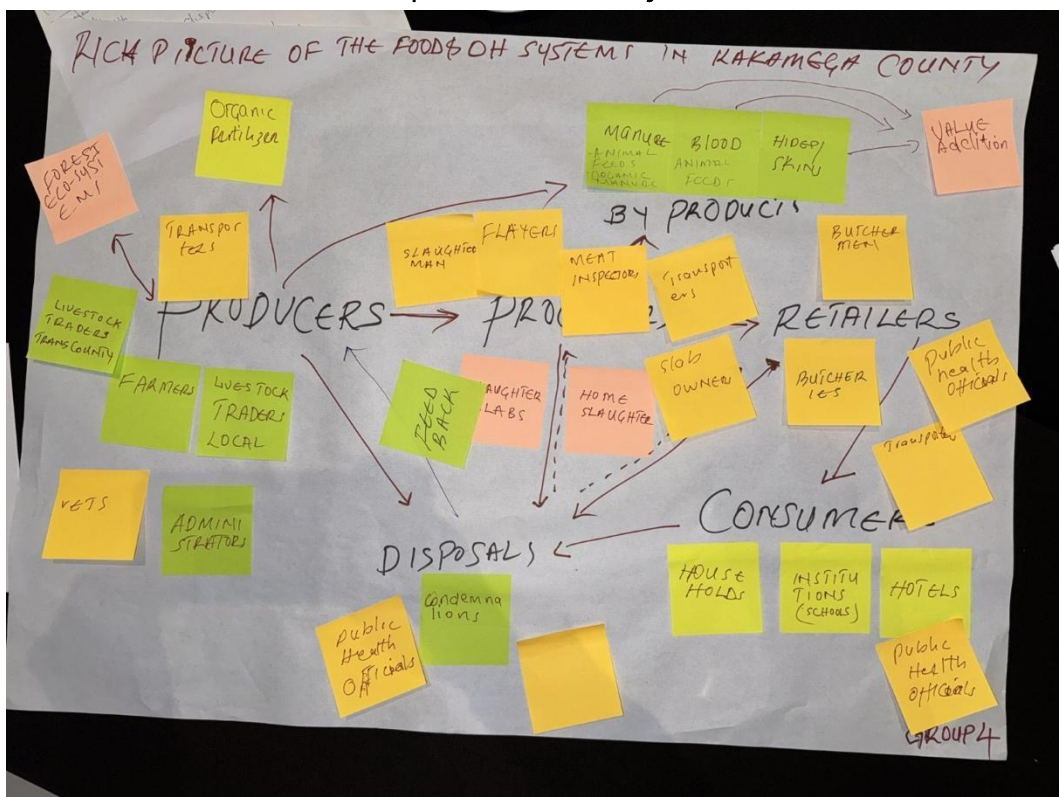
Group 2: Maize Production System



Group 3: Dairy Production System



Group 4: Beef Production System



f. Facilitated zoonotic disease prioritization

This activity aimed to identify a priority zoonosis for the Kakamega COHU to address by adopting ZoNoHSync (Figure 9). The process involved group work, discussions, and a structured prioritization method. After presenting the results of the various evaluations presented above, participants first visualised and reflected on the food system rich picture that they had created, considering when, where, and how zoonotic diseases occur and the impacts they have on the food system. Each group identified two to three zoonotic diseases they deemed critical and provided reasons for their selection.

The groups then presented their identified zoonotic diseases in a plenary session. Similar disease challenges were clustered together to avoid redundancy. After the group presentations, participants engaged in a voting exercise to prioritise the zoonoses. Each participant received three sticky notes to allocate to their top three preferred zoonotic diseases. The disease that received the most votes was designated as the priority zoonosis for COHU to address with ZoNoHSync.

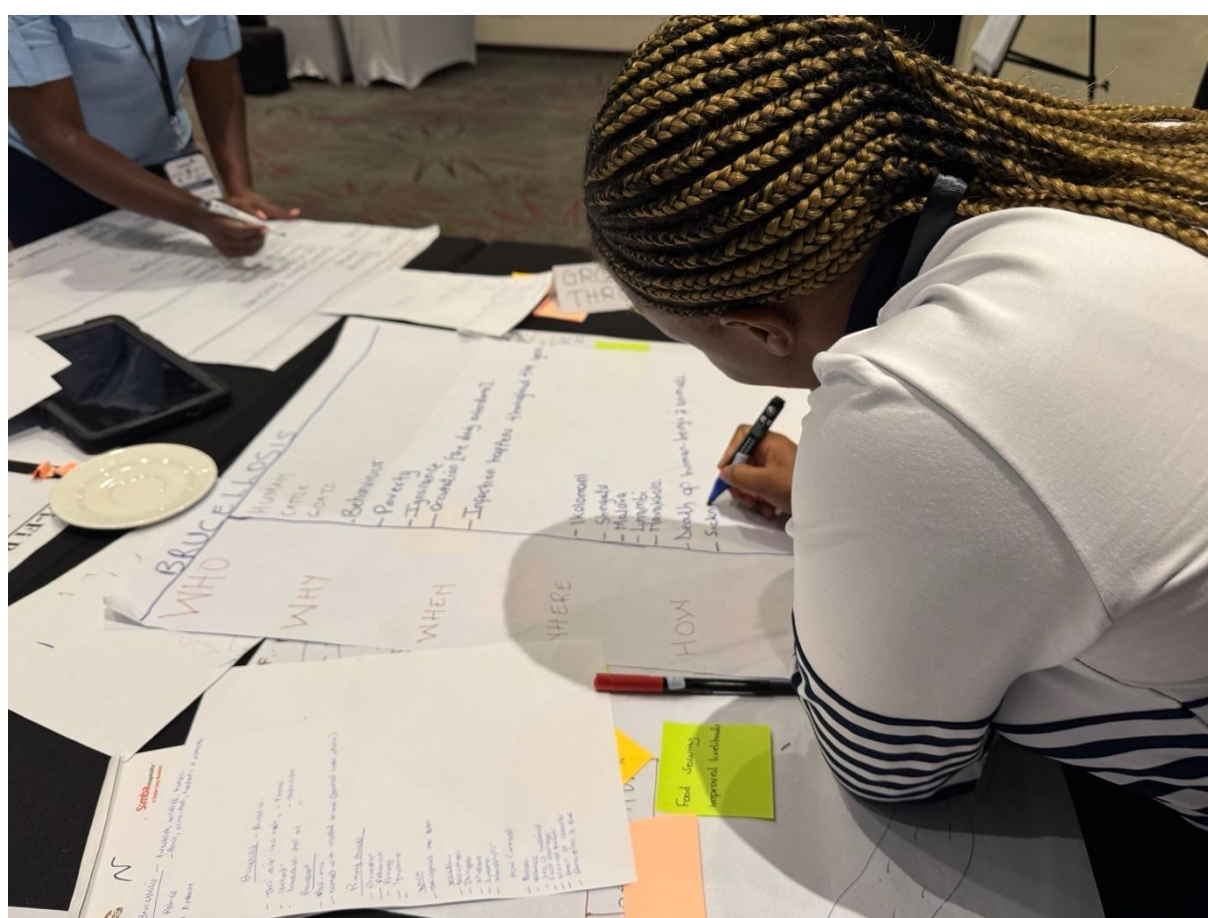


Figure 9 Participants during group work sessions prioritizing their top 3 zoonotic diseases

The prioritization exercise identified anthrax, rabies, and brucellosis as the most pressing zoonotic diseases in Kakamega County (Figure 10). These diseases were selected based on their prevalence, public health impact, and socio-economic consequences. Discussions highlighted the need for improved vaccination programs, public health surveillance, and community education to reduce the incidence of these diseases. In addition to identifying the zoonotic diseases, the workshop participants also highlighted the estimated costs associated with the zoonoses treatment versus prevention. For rabies, the total cost of human post-exposure treatment, including vaccinations, consultations, and transport, was estimated at Kshs 43,000 per person, while vaccination of dogs costs approximately Kshs 2,000 per dog. Anthrax treatment for humans was estimated at Kshs 8,800, with animal vaccination costing Kshs 500 per animal. Brucellosis treatment for humans was estimated at Kshs 7,300, while

culling infected animals could result in significant losses, with the cost of culling a bull estimated at Kshs 60,000 and a cow at Kshs 70,000. These costs underscore the significant financial burden that zoonotic diseases can place on individuals and communities in Kakamega.

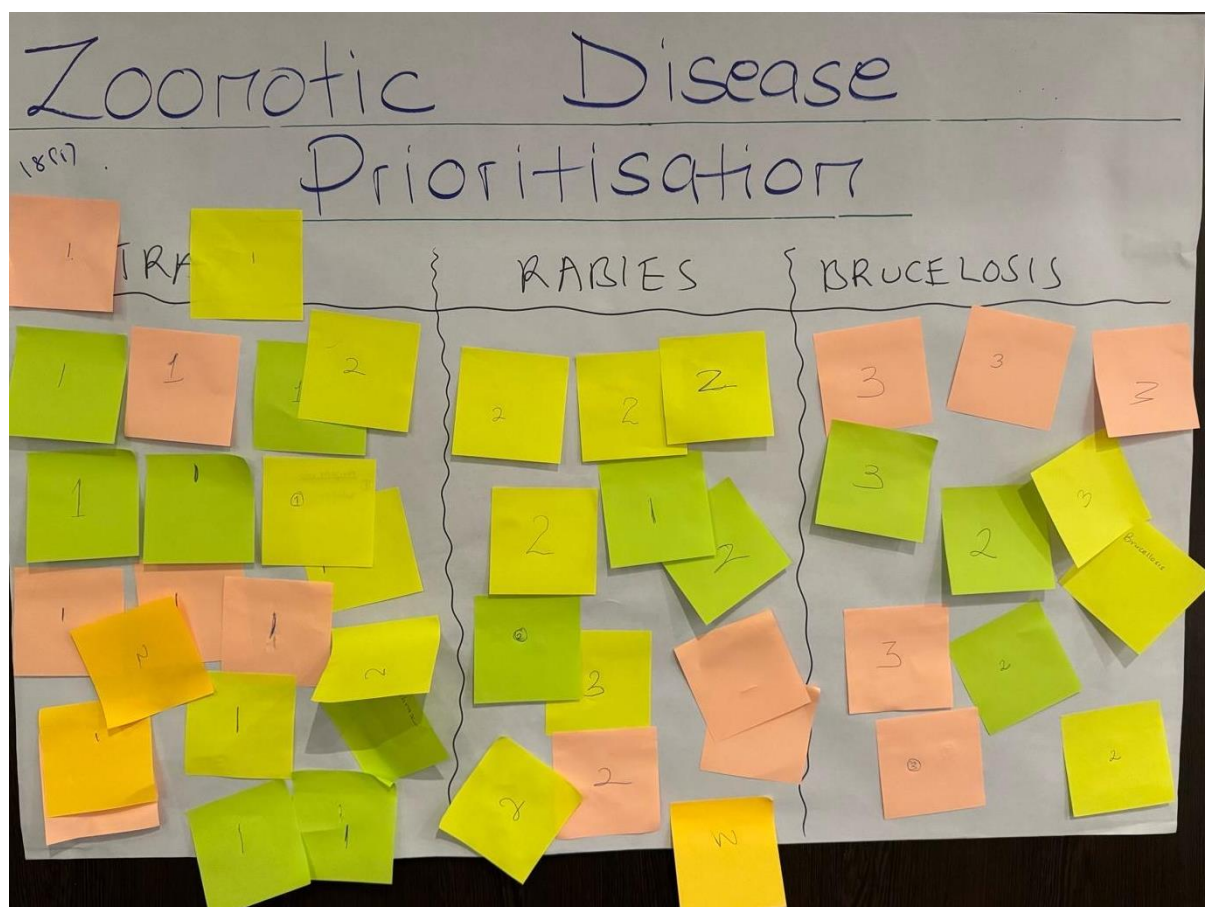


Figure 10 Prioritization exercise identified anthrax as the most pressing zoonotic disease in Kakamega County

g. Conclusion – lessons learned in workshop 1

Both the COHU and community surveys indicated that rabies, anthrax, and brucellosis are significant threats to public and animal health in Kakamega County, anthrax was selected as a priority zoonotic disease to be addressed with ZoNoHSync. The surveys highlight the urgent need for a multi-sectoral approach, practical interventions like vaccination campaigns and awareness programs, as well as policy measures such as increased funding and enhanced surveillance systems. Further research into the environmental and socio-economic factors contributing to disease outbreaks was also identified, as necessary. By addressing these issues through a coordinated One Health approach, Kakamega County can significantly reduce the impact of zoonotic diseases on its population.

Intragroup and plenary session deliberations, favoured a shared understanding of the food system and zoonotic pressure in Kakamega. It highlighted community education, capacity building, waste & environmental management, and collaborative efforts as the key intervention points for strengthening food safety, mitigating zoonotic risks, reducing contamination and transmission, and efficient management of zoonoses respectively.

7. Zoonosis analytics

a. Introduction

After prioritizing a zoonotic disease, the main objective of the next ZoNoHSync step was to co-create a holistic overview of the socio-economic and environmental impacts of the disease in the county food system, and to identify a key zoonotic effect in a primary hotspot with its root cause to be addressed by COHU. The objectives were:

- Build a shared, holistic understanding of i) the socio-economic and environmental impacts of the selected zoonoses in the food system, ii) One Health outcomes of the food system and iii) how they relate to each other.
- Identify a key zoonotic effect to be addressed in a food system hotspot and its root causes.
- Identify the key stakeholders having an influence and interest on the selected zoonotic challenge.

The results are presented in the section below.

b. Quick scan

The ZoNoH team performed a desktop study of anthrax in the Kakamega food system, combining a food system perspective ([Foresight4Food model](#)) and a One Health approach. While this initial desktop study was qualitative, an exploratory quantitative assessment was also made by the ZoNoH team. This rapid assessment is meant to summarize the anthrax transmission route in the food system, main drivers affecting the disease and its impact and One Health outcomes. It combines a health, socio-economic and environmental lens to allow COHU members to gain a holistic perspective on the impact of anthrax in Kakamega. The initial draft has been reviewed and validated by COHU members.

A dedicated detailed report captures this analysis and will be summarized for this report ([Quick scan: the impacts of Anthrax in Kakamega food system](#)).

- **Key anthrax contamination risks in the Kakamega food system** (Figure 12 - topFigure 11)

The quick scan highlighted risks at various stages in the food system; i) production stage, including in farms, pastures, and manure, providing a transmission route for the disease, exposing humans and domestic animals; ii) processing sites-slaughterhouses, butcheries, and home-based slaughtering-posed high risks to workers and the environment, especially during handling and disposal of infected animals and waste, often without precautions, threatening both humans and wildlife iii) storage and holding facilities, such as butcher shops, live animal markets and collection points, also presented contamination risks to humans, other animals and the environment; and iv) retail outlets through butcheries and informal markets increase exposure, while consumption in households and eateries remains a major risk.

- **Drivers of anthrax transmission in the food system** (Figure 12 - bottom)

Socio-cultural factors

Informal cattle marketing in Kenya increases anthrax risks due to unmonitored livestock movement across regions and contact with contaminated soil. Home slaughter, meat sharing, and feeding infected carcasses to dogs exacerbate this. In Kakamega, increased use of mobile phones speeds up information about meat availability, potentially spreading contaminated meat. Handling infected carcasses during butchering and transport can cause cutaneous anthrax. Skinning carcasses before burial and drying meat, mistakenly thought to kill pathogens, may lead to environmental contamination and human exposure. Rising demand for animal protein, coupled with the preference for freshly slaughtered meat increases risk of gastrointestinal anthrax. Transmission of anthrax is exacerbated by poor handling and consumption of contaminated and/or undercooked meat, especially when paired with alcohol.

Demographic factors

Kakamega County's growing population and high population density are key factors influencing anthrax risk, as demand for red meat, particularly in urban areas, continues to rise due to population growth, market accessibility, and financial improvements. Income disparities influence meat consumption patterns, with low-income households prioritizing affordability over quality, making them more vulnerable to exposure to contaminated meat.

Rural population growth and mining activities that disturb soil potentially exposing anthrax spores have increased land pressure leading to reduced grazing land, forcing livestock onto unsuitable, potentially anthrax-contaminated areas. Grazing behaviour influences anthrax risk, as cattle and sheep, which feed close to the soil, are more susceptible to contamination than browsing animals like goats, as studies by Muturi et al., 2018, have shown a higher anthrax morbidity and mortality in cattle, suggesting species-specific vulnerability.

In the report by Gachohi et al. 2022, Kakamega was determined to be in a high risk area for anthrax, shown in Figure 10 below. Further, Kakamega's high livestock population, particularly cattle, and geographic proximity to Vihiga County, another high-incidence anthrax area, increases transmission risks through live animal trade, meat exchange, and cross-border movement of livestock and by-products (Gachohi et al., 2022).

Environmental factors

Kakamega County is situated in an agro-ecological zone characterized by high temperatures and humidity, alkaline soils with high organic matter, moisture content, and calcium levels, that are suitable for anthrax propagation occasioning outbreaks linked to seasonal weather extremes. The climate favors livestock farming, increasing anthrax-susceptible host populations. Land scarcity forces closer interactions between humans, domestic animals, and wildlife, driving environmental cross-contamination heightening transmission risks due to poor water management allowing spores to disseminate through runoff.

Conclusion

Anthrax poses a major health concern in Kenya, with its impact often underestimated due to limited surveillance. Despite regulations for agriculture, food safety, and public health, poor monitoring and enforcement are structural weak points that enable its spread. While vaccination efforts are insufficient, Kakamega County has launched a free cattle vaccination campaign to curb the disease from nearby regions. Digitalising surveillance, such as the electronic integrated disease surveillance and response (eIDSR), enhances outbreak monitoring and response. Resources like CABI improve tracking and control, raising consumer awareness and reducing risks. Strengthening surveillance, enforcement, and vaccination is crucial to manage anthrax outbreaks.

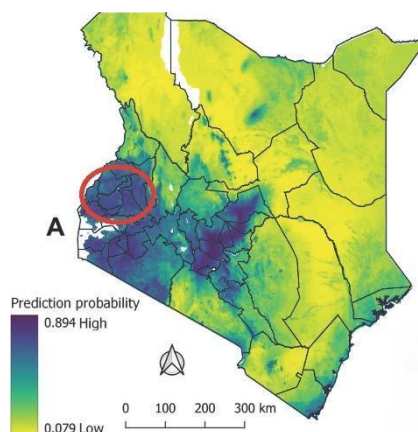
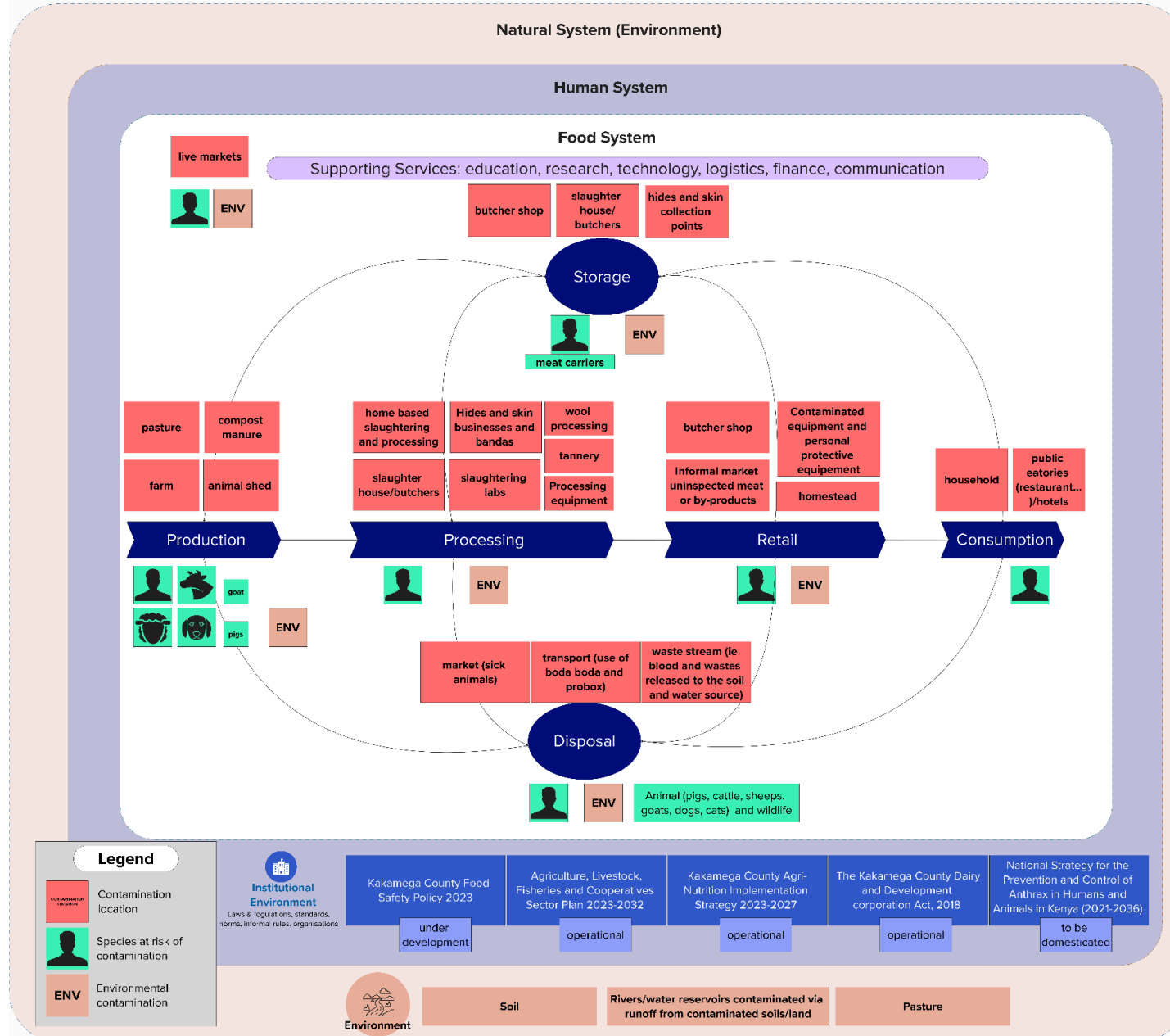


Figure 11 Extrapolated geographic prediction for anthrax to the whole of Kenya landscape (source: Gachohi et al. 2022 – adapted with county boundaries superimposed and Kakamega County circled)

- **Outcomes of anthrax in the food system**

Anthrax significantly disrupts Kakamega's food system, impacting human, animal, and environmental health (Figure 11). In humans, it causes serious illness requiring prolonged treatment and instills fear due to resilient spores existing in the soil, while high mortality in livestock threatens food security. Economically, anthrax leads to increased treatment costs, decreased workforce availability, and reduced livestock trade, affecting tourism (bullfighting events). Environmentally, it lowers farm productivity and increases livestock's ecological footprint, exacerbating land-use conflicts. From a One Health perspective, it harms human well-being (via disability-adjusted life years, DALYs), impedes animal health (limited vaccines), and weakens environmental resilience (antimicrobial resistance, climate vulnerability). However, response efforts have strengthened local health infrastructure and interoperability.

Anthrax contamination pattern in Kakamega food system



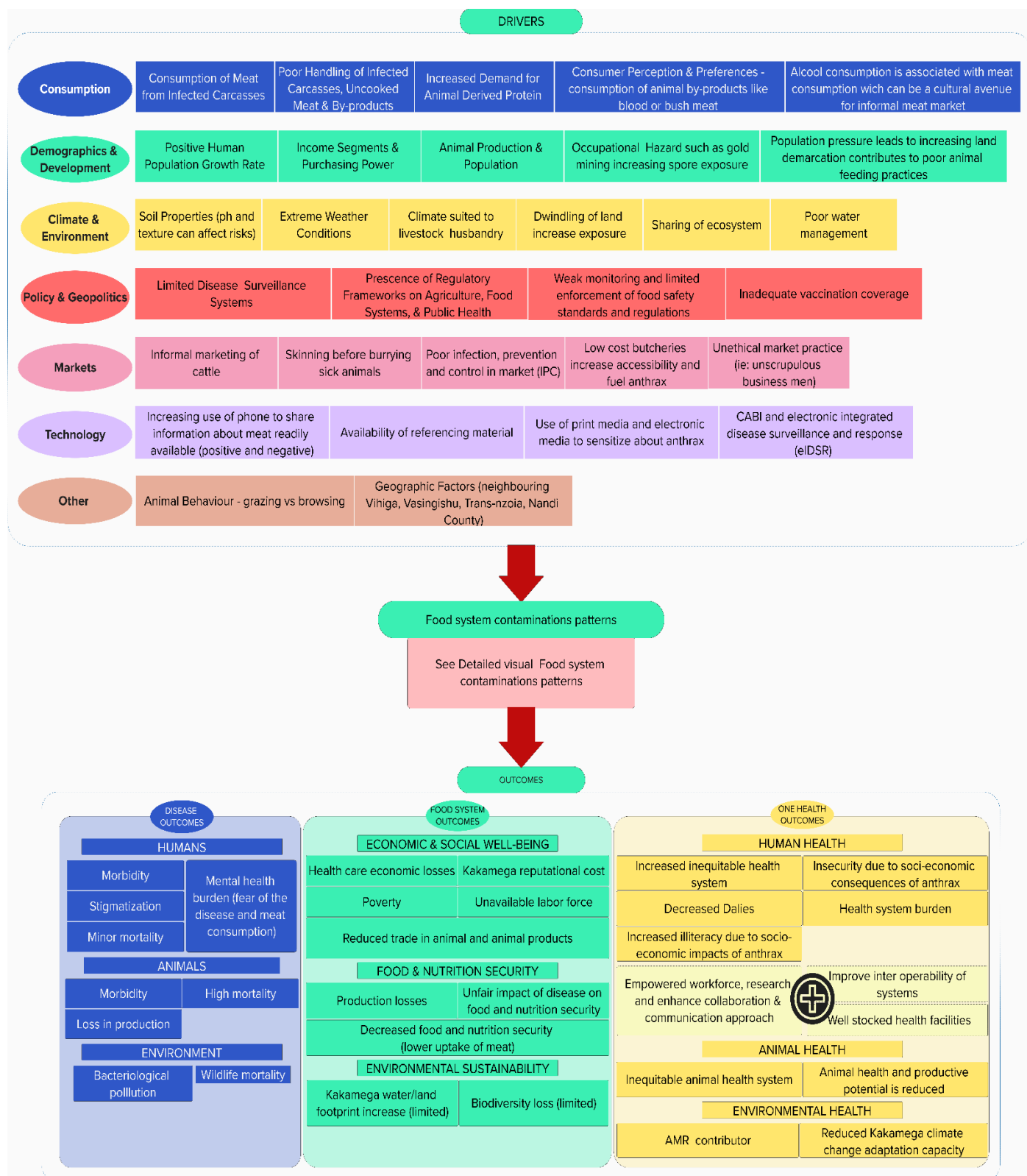


Figure 12 Drivers and outcomes of anthrax in Kakamega food system

c. Identifying the primary hotspot & key zoonotic effect in the primary hotspot

A primary hotspot was defined as a location that had the highest incidence of zoonotic disease emergence. Two COHU representatives identified Ikolomani, Shinyalu, & Khwisero as the top three sub-counties with the highest incidence of anthrax in Kakamega County (Figure 13).

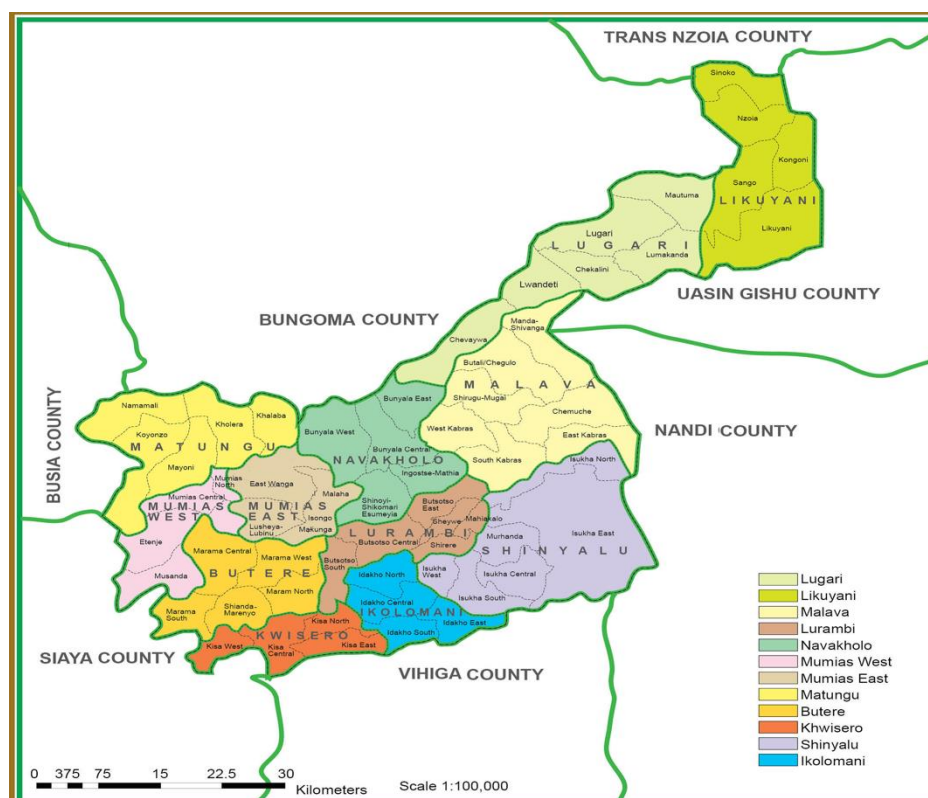


Figure 13 Kakamega sub-counties

Farms were identified as the primary hotspot for zoonotic disease transmission in the food system, with morbidity/mortality, along with economic and production losses, being key effects of anthrax in order of priority in Kakamega County. Accordingly, the focus shifted to livestock mortality and morbidity in Ikolomani sub-county. This identification and scoring help the COHU effectively plan and allocate resources for zoonotic disease control.

d. Causal loop diagram on primary hotspot and key zoonotic effect

Workshop participants were introduced to causal loop diagrams (CLDs), a systems thinking tool described by Posthumus et al. (2021) to visualize the elements within a system and their causal interconnections, enabling a holistic understanding of systemic patterns and dynamics of anthrax in the hotspot sub-county of Ikolomani. Livestock mortality/morbidity at the farm level was determined to be the key effect (Figure 14). In small groups, participants developed four CLDs, identifying feedback loops tied to home skinning of dead animals, herd vaccination, farmers' knowledge, and household income.

Post-workshop, the ZoNoH team synthesized these into a single integrated CLD, incorporating insights from the prior quick scan to ensure comprehensive inclusion of drivers, activities, and outcomes. This refined diagram revealed three additional feedback loops: i) carcass disposal/public anthrax management, ii) resource availability for outbreak response, and iii) consumption of contaminated carcasses.



Figure 14 Workshop participants analysing CLD feedback loop

e. Identifying leverage points in the system (using CLD)

The workshop participants analysed the CLD feedback loops in pairs, validating findings in plenary sessions, and identifying system leverage points—key areas where minor changes could yield major impacts. Leverage points were prioritized using the Futures Wheel method (Glenn, 2009), a brainstorming tool to assess ripple effects, and ranked by potential benefits. The top three selected leverage points were: i) enhanced farmer knowledge/community engagement, ii) strengthened disease surveillance via policy development, and iii) improved stakeholder engagement. Additional points included increased vaccination coverage, expanded veterinary resources, and reduced consumption of contaminated carcasses. This structured approach ensured consensus on actionable strategies with the highest anticipated systemic impact.

f. Stakeholder analysis

To understand livestock mortality and morbidity from anthrax in Ikolomani sub-county, the COHU conducted a stakeholder analysis. This structured session identified and classified key stakeholders in the zoonotic hotspot within the food system and One Health domain, emphasizing their resources and influence.

The methodology included a presentation on stakeholder analysis concepts, followed by participants reviewing Kakamega County's stakeholder landscape. They identified key actors and their roles, leading to small group brainstorming to list potential stakeholders on sticky notes. The notes were consolidated into a stakeholder identification matrix based on their relevance to the zoonotic challenge. A 2x2 importance-influence (low-high importance x low-high influence) matrix was created to categorize stakeholders into quadrants, aiding in developing engagement strategies. A linkage matrix visualized relationships among stakeholders to identify collaboration opportunities.

After completing the stakeholder mapping, participants decided to invite three additional organizations—International Federation of Red Cross and Red Crescent Societies (IFRC), the Chair Farmers Association, and USAID Boresha Jamii (UBJ)—to co-create solutions to better manage anthrax. High importance/influence stakeholders were identified through a voting process and prioritized to be contacted by the ZoNoH team and COHU. Each organization received a briefing on ZoNoH products, an introduction to systems thinking, and invitations to

participate in future ZoNoH activities with the COHU, as the COHU+. This collaborative approach ensured greater stakeholder involvement, laying the groundwork for a more inclusive and sustainable response to zoonotic disease challenges.

g. Identifying current efforts targeting anthrax

The analysis of ongoing anthrax prevention and control efforts in Kakamega County involved reviewing existing frameworks, national and county-level policies, and relevant programs. The **key stakeholders** in anthrax control, including the Directorate of Veterinary Services (DVS), Kenya Wildlife Service (KWS), and ZDU, were identified as critical actors. Various **national frameworks** (e.g., National Action Plan for Health Security, Kenya Veterinary Policy, and One Health Strategic Plan) guide the control measures, while **county-specific frameworks** like the County Integrated Development Plan (CIDP) provide localized solutions for anthrax prevention and mitigation.

Existing efforts were examined based on **surveillance, vaccination campaigns, and wildlife management**, including logistics for wildlife vaccination and carcass disposal during outbreaks. Stakeholder coordination was assessed, especially in light of challenges such as logistical barriers, resource limitations, and policy gaps.

Current efforts

1. National-level initiatives

- a. **DVS** is responsible for animal vaccination and carcass disposal, but often operates reactively during outbreaks.
- b. **KWS** addresses wildlife vaccination and provides alternative water points in outbreak zones to minimise infection cycles.
- c. Public education and mass treatment with penicillin are conducted during outbreaks.
- d. **ZDU** coordinates the outbreak response and provides epidemiological support.

2. Kakamega County initiatives

- a. The **CIDP 2023–2027** emphasizes improving veterinary services, disease surveillance, and public awareness in response to zoonotic diseases, including anthrax.
- b. **One Health Implementation Plan** focuses on collaborative efforts among county departments for zoonotic disease control.
- c. **County Veterinary Services Framework** manages vaccination and surveillance activities tailored to endemic areas, with an emphasis on anthrax prevention.

3. Projects and programs

- a. **ZooLink Project** supports integrated zoonotic disease surveillance, involving animal and human health teams in Kakamega and surrounding counties.
- b. The **One Health Joint Plan of Action (2022–2026)** focuses on enhancing preparedness for zoonotic diseases, including anthrax, particularly at cross-border points in Kakamega.
- c. The **Kenya Animal Biosurveillance System** training initiative aims to strengthen the capacity of animal health workers in early detection and response to zoonotic diseases, including anthrax.

From this analysis, some insights were collected to inform the COHU+ (COHU + stakeholders) efforts:

- **Fragmented efforts:** National and county efforts remain fragmented, with weak coordination between stakeholders, leading to inefficient responses.
- **Challenges:** Key challenges identified include logistical difficulties in wildlife management, lack of standardized case management guidelines, and limited resources for consistent vaccination and surveillance programs.
- **Strategic gaps:** The absence of an integrated approach for zoonotic disease control at both national and county levels hinders effective implementation, particularly in remote areas where anthrax outbreaks are more likely.
- **Resource and capacity needs:** There is an urgent need for improved **resource allocation, stakeholder coordination**, and the **establishment of standardized practices** to strengthen the overall response to anthrax in Kakamega County.

h. Conclusion – lessons learned

There is a critical need for a more cohesive approach to anthrax prevention and control, including stronger inter-agency collaboration, consistent resource distribution, and standardized outbreak management practices. The ZoNoHSync analysis revealed that using a One Health approach coupled with food system tools can effectively assess the broader impacts of zoonotic diseases beyond public health. In Kakamega, anthrax is primarily linked to the informal meat market, directing focus to farm level livestock mortality and morbidity in Ikolomani sub-county. Key leverage points identified for improvement include: 1) enhancing farmer knowledge and community engagement, 2) strengthening disease surveillance through policy development, and 3) improving stakeholder engagement. To bolster stakeholder involvement and ensure an inclusive response to zoonotic challenges, three additional groups—IFRC, the Chair Farmers Association, and UBJ—were added to the COHU, creating the COHU+.

8. Co-creation of an integrated solution

a. Introduction

This section describes the co-creation process of a viable solution to manage anthrax in Ikolomani as prioritized by the COHU members. More specifically, this step had several objectives:

- To collaboratively identify a viable solution to manage anthrax in Ikolomani
- Ensure the solution is relevant, practical, feasible and fundable.
- Design a solution that COHUs can readily implement with minimal support from ZoNoH, and maintain independently post-ZoNoH.
- Ensure alignment with the Kenya National One Health strategy 2021-2025.

b. Theory of Action visual & narrative

ToA - Methodology

ToA is a shorter term version of a [theory of change](#) (Es, M. van, Guijt, I., & Vogel, I. 2015). It is both a visual and narrative defined at a specific moment, and should be seen as a compass for the COHU to guide them in meeting their ambitions to prevent anthrax.

Building on previous steps, COHU members and invited stakeholders were introduced to a methodology commonly used by donors. They first defined a joint vision to align efforts in preventing anthrax. For each identified leverage point, milestones and actions were outlined, resulting in the first draft ToA by the COHU+. The ZoNoH team then revised and expanded this draft, and prepared a feasibility study. The revised draft and feasibility study were shared with the COHU+ to add final adjustments to the final ToA, which provided initial guidance for preventing anthrax in Ikolomani. The ToA will be regularly updated to monitor progress and support adaptive management of the initiative.

ToA - Narrative

A ToA was produced as a visual: an extended version is included in Annex 1 and a condensed visual below (Figure 15). The narrative of this ToA is as follows..

The problem and vision: The high incidence of anthrax in Ikolomani has caused significant farm-level livestock morbidity and mortality. To combat this, the Kakamega COHU and partners aim to transform Ikolomani into an anthrax-free model sub-county by 2030, fostering healthy and wealthy communities. Their ToA is anchored on rapidly detecting, preventing and controlling anthrax, and it includes three strategic pathways: i) emphasizing community behaviour change, ii) strengthening surveillance and reporting systems, and iii) policy implementation, and mobilizing resources and partnerships.

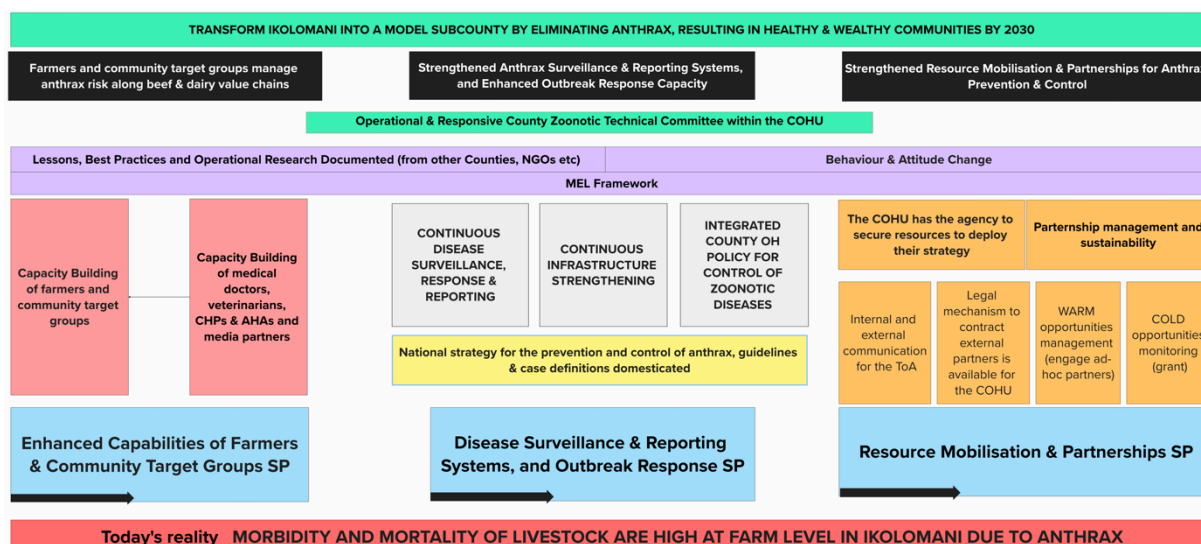


Figure 15 An abridged version of the Theory of Action

Strategic Pathway 1: Farmers and community groups manage anthrax risk along beef and dairy value chains - Farmers and community groups will identify knowledge gaps and behaviours contributing to the spread of anthrax. Activities include a baseline survey, engaging behaviour change experts, and developing risk communication plans. Training will focus on biosafety, biosecurity, carcass disposal, vaccination, and disease reporting, aiming to increase reporting of suspected cases, reduce risky practices, and enhance collaboration with authorities and media.

Strategic Pathway 2: Strengthened anthrax surveillance and reporting systems, and enhanced outbreak response capacity - This pathway aims to strengthen anthrax surveillance and reporting systems and enhance outbreak response capacity in alignment with Kenya's National Strategy. Key activities include improving laboratory infrastructure, integrating veterinary and human health surveillance, conducting joint response exercises, and developing supportive policies. An operational County Zoonotic Technical Committee (to be housed within the COHU) will oversee policy reviews, monitoring and evaluation, and stakeholder engagement to ensure effective disease prevention.

Strategic Pathway 3: Strengthened resource mobilisation and partnerships for anthrax prevention and control - Focused on securing sustainable funding and partnerships, this pathway involves a designated resource mobilizer collaborating with government, NGOs, private sectors, and community organizations. It emphasizes stakeholder engagement, developing memorandums of understanding, and action plans for resource allocation. Regular outreach will raise awareness of anthrax prevention goals to secure consistent funding and leverage expertise.

Risks and Assumptions: Potential risks include new or re-emerging diseases, inconsistent funding, environmental challenges, and community resistance to vaccination. Political changes and livestock movements can also disrupt progress. The theory assumes community behaviour will change, political support will continue, funding will remain stable, and coordination among sectors will persist. If these conditions are met, Ikolomani can significantly reduce anthrax cases, achieving healthier and wealthier communities by 2030.

c. Conclusion – lessons learnt

By co-creating a joint ToA, the COHU and their partners can better coordinate their actions to prevent anthrax in Ikolomani. This ToA is meant to inform adaptive management of their strategy implementation. It can be used as a compass to guide their actions in the coming years, allow them to learn from their mistakes, and continue work towards their common vision.

9. ZoNoHSync – a collective journey

a. Introduction

Beyond the tangible products and analysis, the collective process is an essential added value of ZoNoHSync. It builds on existing scientific concepts and methodology detailed below.

b. Multi-stakeholder partnerships : at the heart of One Health

Preventing zoonoses is a complex challenge that cannot be tackled in isolation. Multi-stakeholder partnerships (MSPs) are essential, as organizations often realize they cannot achieve their goals alone. Understanding complex adaptive systems is crucial for governance and societal change, shifting focus from rigid control to fostering conditions that allow systems to adapt and evolve positively.

Effective change is driven by improving shared understanding, feedback, and relationships between various actors, which is the goal of MSPs and the ambition of ZoNoH. In a complex world, these partnerships become vital for governance. By embracing human societies as complex adaptive systems, engaging in MSPs can facilitate transformative change towards sustainability and equity.

For more information on MSPs, refer to the MSP guide (Brouwer et al. 2016), a handbook with resources for embracing adaptive changes.

c. Dynamic Learning Agenda

The Dynamic Learning Agenda (DLA) was implemented to boost teamwork and foster continuous learning. It serves as a flexible monitoring tool across various team settings. The DLA process began with open discussions to collect feedback on successes and areas for improvement.

Participants engaged in interactive sessions using coloured sticky notes to share positive experiences and identify challenges. These insights were analysed collectively, leading to actionable plans that leveraged strengths and addressed issues.

The DLA outcomes from the workshops emphasized participatory engagement, with participants appreciating ZoNoH's straightforward and engaging tools. However, challenges like limited time and jargon were highlighted, leading to suggestions for clearer communication and longer sessions. Overall, the workshops underscored the value of co-creation and iterative improvement, reinforcing ownership and accountability as essential for the success of collaborative projects.

d. ZoNoHSync: a team building and learning journey

During the engagement with the Kakamega COHU, ZoNoH utilized team-building, participatory methods, and capacity-building approaches to foster collaboration and empower participants. These strategies created an interactive environment that encouraged active participation, knowledge sharing, and skill development, enhancing the team's ownership and problem-solving capabilities.

Methods such as group discussions, brainstorming, and collaborative problem-solving promoted peer learning. Icebreakers and world café discussions fostered open dialogue and diverse perspectives, while collaborative decision-making empowered participants, fostering ownership and accountability.

Capacity-building exercises like mentoring and resource sharing provided personalized guidance, equipping participants with tools for effective future initiatives. This integration of methods facilitated active learning, continuous improvement, and informed decision-making, positioning the Kakamega COHU team to address future challenges with enhanced collaboration and critical thinking.

10. Conclusion

The ZoNoH One Health project piloted in Kakamega County, Kenya, marks a transformative effort in addressing the escalating risks of zoonotic diseases in the food system through a coordinated One Health approach. By establishing Kakamega COHU, the 14th in Kenya, the project highlights the need for integrated strategies to combat zoonotic threats that affect health, economics, and the environment in Kenya and beyond.

Key outcomes identified anthrax as the most critical zoonotic disease in Kakamega, validated by community survey, expert input, and workshops. Tools like the quick scan and CLDs helped stakeholders understand disease transmission dynamics and develop actionable interventions. Strategic priorities included enhancing farmer education, improving vaccination rates, strengthening surveillance systems, and aligning efforts with Kenya's National One Health Strategy.

Participatory methodologies such as DLA and stakeholder mapping ensured local ownership and adaptive capacity building, bridging gaps between sectors and uniting environmentalists, veterinarians, and public health officials. The creation of the COHU+ expanded partnerships with organizations like the Red Cross, USAID BMJ, and the Ikolomani Farmers Association, enhancing resource mobilization.

Challenges like reactive disease management, funding constraints, and weak enforcement of standards were identified. The project highlighted the socioeconomic impacts of zoonoses, such as the estimated Kshs 8,800 treatment cost for anthrax per household, and additional livestock losses. By integrating food systems and One Health perspectives, ZoNoH demonstrated that comprehensive interventions can reduce contamination risks while improving food security and environmental sustainability.

Looking forward, the launch of the One Health Strategic Plan (2024–2029) and the signing of an interdepartmental MoU are pivotal milestones that position Kakamega County as a model for operationalizing One Health within Kenya's decentralized governance. Successful scaling of the ZoNoH approach in other high-risk areas will require ongoing political commitment, donor investment, and knowledge-sharing.

In conclusion, ZoNoH illustrates the effectiveness of science, collaboration, and community-driven solutions in managing zoonotic diseases. By empowering local decision-makers and emphasizing inclusivity, the initiative not only addresses immediate health challenges but also builds resilience against future pandemics, setting a precedent for global efforts to integrate human, animal, and environmental health for sustainable communities.

11. Future of ZoNoH

ZoNoH will continue to support Kakamega county by supporting them to explore the financial feasibility of this ToA and the possible partnership to establish to ensure its financial viability. A joint virtual launching event is planned to be organised in May 2025. Furthermore, ZoNoH hopes to be able to support the COHU+ to continue its journey towards increased agency to mitigate zoonoses through strengthened governance.

Beyond the collaboration with Kakamega, a larger project is envisioned with a partnership between Europe, Kenya, Somalia and Ethiopia. Building on the ongoing partnership, ZoNoH 2.0 unites a consortium of leading organizations in the One Health field, leveraging the strengths of the [ZoNoH project](#) and the [HEAL project](#) to deliver impactful solutions aligned with the Sustainable Development Goals (SDGs).

Our vision is simple yet ambitious: Do more with less by maximizing the efficiency of resource use to enhance One Health for all hence contributing to the SDGs. Our goal is to mainstream practical One Health solutions for decision-makers at all levels—local, sub-national, and national. At this stage we are exploring options for funding.

13. ZoNoH Team



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ZoNoH Partners

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The following individuals have played a key role in contributing to the project:

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- Dr Asaah Ndambi
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14. Annex 1 - Narrative ToA Kakamega

The [Theory of Action Kakamega](#) maps the specific pathways for intervention to control anthrax in the local food systems of Ikolomani sub-County in Kakamega County. It maps the objectives, activities, milestones and outcomes of the proposed interventions, ultimately leading to the transformation of Ikolomani into a model sub-County by eliminating anthrax and improving the health and economic outcomes of the residents.

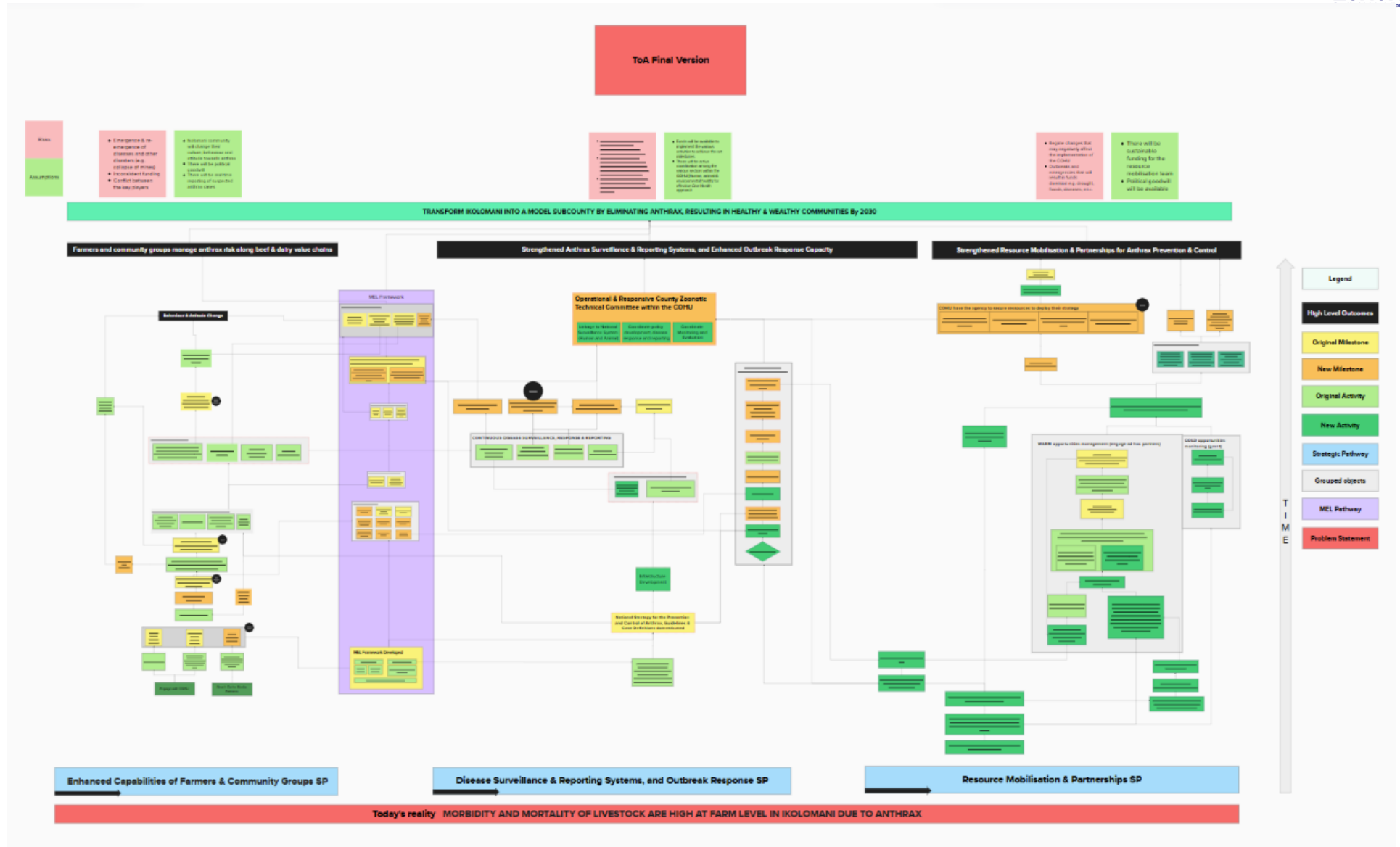


Figure 16: Theory of Action Kakamega