THE LEGACY OF AFRICA ONE HEALTH UNIVERSITY NETWORK (AFROHUN)

REVOLUTIONISING ONE HEALTH WORKFORCE DEVELOPMENT IN AFRICA

AFROHUN
Advancing One Health

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The Legacy of Africa One Health University Network: Revolutionising One Health Workforce Development in Africa (2009-2024)

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Contents

List of Figures

List of Tables

FOREWORD

Despite these challenges, Africa is brimming with opportunities. The continent has the world's youngest population, with 70% of Africans under 35 and over a third between 15 and 34.

I am humbled and feel privileged to write this foreword for the history of the Africa One Health University Network (AFROHUN). The journey has been long but worth it as you will experience as you read. In this book, readers will find an invaluable compilation of insights, experiences, and case studies from across the continent. These contributions highlight the critical role of interdisciplinary education and collaborative research in building a resilient health workforce. They also underscore the importance of local context and cultural competence in designing and implementing effective health interventions.

The concept of One Health integrates human health, animal health, and ecosystem health to address and manage complex global health challenges and emergencies. This pre-emptive approach anticipates health crises before they occur through collaboration, multidisciplinary efforts, and a transboundary perspective.

Africa, with its complex history, biodiversity, ecosystems, and diverse populations, presents unique challenges in managing health outcomes. The continent's colonial past resulted in varied health systems that resist easy integration. Additionally, Africa's vast geographical, ecological, and natural diversity complicates integration efforts. Post-colonial challenges, such as unstable regimes and nation-building pains, have also impacted Africa's health landscape.

Despite these challenges, Africa is brimming with opportunities. The continent has the world's youngest population, with 70% of Africans under 35 and over a third between 15 and 34. Many young Africans are multilingual, educated, and ready to join the workforce, including the One Health sector. Africa's rapidly expanding population, projected to exceed 1.7 billion by 2030, attracts investors, including those in health systems. Furthermore,

improved governance is leading to better health outcomes across the continent.

The Africa One Health University Network (AFROHUN) is at the forefront of championing the One Health approach in Africa. AFROHUN has fostered collaboration among universities, governmental bodies, NGOs, and international partners, creating a robust network aimed at building the One Health workforce for Africa and the world. This network equips African One Health professionals with the knowledge and skills to address complex public health challenges and emergencies.

A compelling aspect of AFROHUN's work is its focus on capacity building. By investing in the education and training of health professionals, AFROHUN ensures that African countries are better prepared to respond to health emergencies and positioned to lead global health initiatives. The network's emphasis on practical, hands-on training ensures graduates are not only theoretically proficient but also capable of applying their knowledge in real-world settings.

I commend the authors and contributors of this book for their dedication and commitment to advancing the One Health agenda in Africa. Their work exemplifies the spirit of innovation and collaboration essential for tackling the complex health challenges of our time.

As we navigate an increasingly interconnected world, the principles and practices outlined in this book will be invaluable. They provide a roadmap for other regions and countries seeking to implement a One Health approach and underscore the importance of investing in a holistic, integrated health workforce.

In closing, I extend my heartfelt congratulations to AFROHUN and all those involved in the creation of this seminal work. May it inspire continued progress and catalyse transformative change in health systems worldwide.

Professor Philemon Nyangi Wambura
Chair - AFROHUN Board

FOREWORD

I had the privilege of being part of AFROHUN's journey. In 2005, when I was at USAID as head of the Emerging Pandemic Threats Programme, we identified a gap in the leadership capacity of the health service delivery system in the East African region.

It is with great pleasure and pride that I pen this foreword for the book, "Africa One Health University Network: Building the One Health Workforce for Africa." This book is a testament to the innovation and resilience of One Health professionals and students drawn from Africa's universities. They took up the challenge to change the story of Africa's health system from being one of disconnected parts working to solve complex health challenges to that of a collaborative and well-equipped One Health workforce doing its best to change health outcomes in Africa.

I had the privilege of being part of AFROHUN's journey. In 2005, when I was at USAID as head of the Emerging Pandemic Threats Programme, we identified a gap in the leadership capacity of the health service delivery system in the East African region. This deficit manifested itself in inadequate logistical planning, wanting human resources practices, and generally less-than-best practice administration practices in the health sector.

We at USAID put out a call on the "Leadership Initiative for Public Health in East Africa." The purpose of this call was to put together a strategy to address the leadership gaps that we had identified. USAID was keen to receive proposals on how such challenges would be addressed. This call led to the selection of Makerere University Institute of Public Health and Muhimbili University College, which were tasked to collaborate with two American universities to develop a project that addressed the leadership challenges, and thus, LIPHEA was born. Along with LIPHEA, the Higher Education for Development (HED) Fund was established, which funded the training of managers who could lead and impact the high morbidity and mortality levels in the East African region, as well as strengthen effective public health leadership for Uganda and Tanzania.

Out of these modest but extremely transformational initiatives, the One Health Central and Eastern Africa (OHCEA) Network was born. This effort was led by Professor William Bazeyo and his able team to consolidate the gains achieved under the LIPHEA and HED programmemes and to spread the catchment area of universities and countries benefiting from the training of health managers and the start of building a One Health workforce for Central and Eastern Africa.

Fast forward to 2019, OHCEA had come of age and achieved many milestones, including attracting universities from the Western Africa region. OHCEA then transformed into the Africa One Health University Network (AFROHUN), which has not only continued all the great work LIPHEA, HED, and OHCEA were doing but has taken on the mission of preparing an OH Workforce for Africa to a new level. This has involved setting up the AFROHUN One Health Academy (AOHA) to ensure standardization of the training programmeme that the network implements and the sustainability of the network. The Academy is now fully accredited in Uganda and processes to do so in several other countries, are ongoing.

Dr. Dennis Carroll
Chief Science Officer, URC,
Distinguished Professor of Faculty of Medicine,
Chulalongkorn University

Acknowledgment

We want to thank all our authors, who have been very cooperative in responding to the extensive comments and questions that were originally raised in connection with their chapters. We know that, for non-English speakers in particular, this was a very big job. Thanks to all of you, and we are very happy that some of you have decided to contribute again to other AFROHUN publications and events. We are also grateful to all those who have commented on various drafts of the papers in the book.

The production of this book was made possible with the financial and technical support of the GIZ. The Global Programme Pandemic Prevention and Response, One Health is implemented by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbHmon on behalf of the Federal Ministry for Economic Cooperation and Development. It works with partners to strengthen capacities to prevent and respond to diseases with a One Health approach.

AFROHUN is forever indebted to GIZ for this valuable collaboration that has enabled us to produce this book, which we hope will be a valuable resource for all who desire to understand the network and its impact, and how One Health can be further harnessed and institutionalised in all government operations in managing complex health challenges. We specifically and sincerely thank the Head of the Global Programmeme, Ruth Schumacher, as well as Nicola Watt, Anja Leetz, and Simon Alubbe for the technical support and strategic guidance rendered to us throughout this process. We do not take this for granted.

The bulk of the work that has been documented and featured in this book, was generously funded by USAID since the inception of the network. We are eternally grateful to USAID for enabling us to make this mark on the global workforce development scene, and for the partnerships, this has enabled us to create. We thank the country USAID Missions and the Headquarters in Washington for their unwavering support. Ms. Marilyn Crane and the colleagues she works with to oversee the funding and technical support from USAID, are particularly appreciated. We do thank the US/Global consortia that we have worked with in implementing USAID-funded work; the University of Minnesota and Tufts University consortium, the OHW-NG Global Consortium led by the University of California -Davis, and others. The network has grown to the stature where it is now because of what we have been able to accomplish together and what we have learned from you.

To our other funders, IDRC – Canada and the national and sub-national governments and implementing partners in the different countries, we cannot thank you enough for what you have contributed towards our growth and impact.

Many individuals have put in their time and expertise to ensure that this network does what it was started to do and grows into a formidable global force in workforce development. We do thank the visionaries who through that Africa needed agency in One Health; the faculty that have provided much of the implementation time (Focal Persons, Thematic and Activity Leads, Country Managers and Administrators, the incredible team at the AFROHUN

Secretariat, all support staff), we thank you immensely.

The Editorial Committee led by Dr. Aloysius Ssennyonjo is very much appreciated for the great job done with refining and ensuring the book is a pleasure to read.

The following individuals are thanked for accepting to be interviewed for the compilation of this book and for the support they provided to the writing teams in execution of this task. These are Dr. Dennis Carroll, Prof Mutuku Mwanthi, Ms. Zainab Zobuyonjo, Dr Marc Yamba Yamba, Ms. Esther Ntiyaduhanye, Dr. Jean Paul Mushaija, Dr. Denis Zofou, Dr. Susan Keino, Dr Gilbert Kirui, Dr. Malik Orou Seko, Ms. Angella Musewa, Ms. Sarah Nanyanzihe.

Lastly, we would like to thank the different actors and stakeholders in each country who have worked with us to create awareness about the benefits and value of the One Health approach to solving Africa's and global complex health challenges. We are looking forward to many more decades of collaboration, partnerships and shared rewards.

I would therefore like to recommend this book to everyone who has One Health at heart. It is an amazing story of how dedicated, hardworking professionals in One Health across Africa, can create an initiative that shapes not only their generation but many future generations, too. Congratulations to AFROHUN on this milestone of publishing your story.

Dr. Irene Naigaga
Programmeme Manager - AFROHUN

LIST OF ACRONYMS

AFROHUN	Africa One Health University Network
AMR	Antimicrobial Resistance
AOHA	AFROHUN One Health Academy
AU	African Union
AU-IBAR	African Union-InterAfrican Bureau for Animal Resources
AU-PANVAC	African Union Pan African Veterinary Vaccine Centre
AU-SAFGRAD	African Union Semi-Arid Food Grain Research and Development
ATP	Accredited Training Programmemes
BRM	Bio-risk Management
CAADP	Comprehensive Africa Agricultural Development
CABI	Centre for Agriculture and Biosciences International
CBE	Competency-Based Education
CCC	Country Coordinating Committees
CDC	US Centers for Disease Control and Prevention
CEN	SAD- Community of Sahel-Saharan States
COMESA	Common Market for Eastern and Southern Africa
CoP	Communities of Practice
COVID-19	Coronavirus Disease 2019
DFID	Department for International Development
ECCAS	Economic Community of Central African States
ECOWAS	Economic Community of West African States
ECHO	Extension for Community Health Care Outcomes
EHNRI	Ethiopia Health and Nutrition Research Institute
EPT	Emerging Pandemic Threats
EVD	Ebola Virus Disease
FAO	Food and Agriculture Organisation
FEL	Field Experiential Learning
FELTP	Field Epidemiology and Laboratory Training
FUS	Fédération Une Santé
GEDSI	Gender Equity, Disability and Social Inclusion
GHSA	Global Health Security Agenda
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit/German Development Cooperation
H5N1	Avian influenza

HED	Higher Education for Development
HEMP	Health Emergency Management Programme
HIV/AIDS	Human immunodeficiency virus/Acquired immunodeficiency syndrome
IACUC	Institutional Animal Care and Use Committee
ICT	Information and Communications Technology
IDDS	Infectious Diseases Detection Surveillance
IDM	Infectious Disease Management
IDRC	International Development Research Centre
IGAD	Intergovernmental Authority on Development
IHR	International Health Regulations
ILRI	International Livestock Research Institute
IRB	Institutional Review Board
JEE	Joint External Evaluation
KAP	Knowledge, Attitude and Practice
LIPHEA	Leadership Initiative for Public Health in East Africa
LMICs	Low and Middle-Income Countries
MakSPH	Makerere University, School of Public Health
MDAs	Ministries, Departments and Agencies
MELT	Mentored Experiential Learning and Training
MSH	Management Sciences for Health
MTaPs	The Medicines, Technologies, and Pharmaceutical Services (MTaPS) Programme
MUHAS	Muhimbili University of Health & Allied Sciences
MUST	Mbarara University of Science and Technology
NAP	National Action Plan
ND	New Castle Disease
NEOH	Network of Evaluation of One Health
NGO	Non-Governmental Organisations
NSA	National School of Administration
OAU	Organisation of African Unity
OCHA	United Nations Office for the Coordination of Humanitarian Affairs
OH	One Health
OHCC	One Health Core Competencies
OHCEA	One Health Central and Eastern Africa
OHELM	One Health Experiential Learning Models
OHFA	One Health Field Attachment
OHHLEP	One Health High-Level Expert Panel

OHW	One Health Workforce
OHWA	One Health Workforce Academy
OIE	World Organisation for Animal Health, formerly the Office International des Epizooties
ORIP	OHCEA Research Innovations Project
Pas	pyrrolizidine alkaloids
RCCE	Risk Communication and Community Engagement
RECs	Regional Economic Communities
RE&Is	Research, Ethics and Innovations
RUFORUM	Regional Universities Forum for Capacity Building in Agriculture
RVF	Rift Valley Fever
SADC	Southern African Development Community
SARS	Severe acute respiratory syndrome
SDGs	Sustainable Development Goals
SOHICs	Student One Health Innovations Clubs
STOs	Specialised Technical Offices
STOPS	Strategies to Prevent Spillover
TAC	Technical Advisory Committee
TAMAR	Transition Award Multidisciplinary Action Research
TAPROD	Transition Award Professional Development
TOHFEL	The One Health Field Experiential Learning
TOTs	Training of Trainers
TUCSVM	Tufts University Cummings School of Veterinary Medicine
TUSK	Tufts University Sciences Knowledgebase
UHC	Universal Health Coverage
ULD	Unidentified Liver Disease
UMA	Arab Maghreb Union
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development
USDA	United States Department of Agriculture
VVC	Vaccine Value Chain
WFP	World Food Programme
WHO	World Health Organisation
WOAH	World Organisation for Animal Health

Introduction

By AFROHUN CEO – *Professor William Bazeyo*

The yearning for a healthier Africa, one resilient in the face of emerging health threats, was the genesis of AFROHUN. As the continent grappled with the intricate dance between human, animal, and environmental health, a realization emerged...

Background

We started Africa One Health University Network (AFROHUN), way back in September 2009. When we started, we were known as One Health Central and Eastern Africa (OHCEA). This book is the story of how disparate threads woven from the realms of academia, public health, veterinary sciences, and environmental studies came together, creating a vibrant network that transcended borders, disciplines, and challenges. I am proud to have been a part of this process and it gives me so much pleasure to tell this story.

The yearning for a healthier Africa, one resilient in the face of emerging health threats, was the genesis of AFROHUN. As the continent grappled with the intricate dance between human, animal, and environmental health, a realization emerged—a realization that the traditional silos of knowledge were no longer sufficient to confront the complexities of a rapidly changing world. Thus, the vision of a collaborative network that could pull down the disciplinary boundaries was conceived. As we write this book, AFROHUN is based in 19 different universities and 27 schools of public health, animal health, and environmental science, domiciled in 10 African countries, namely Uganda, Kenya, Tanzania, Cameroon, Senegal, Côte d'Ivoire, Liberia, Ethiopia, Rwanda, and Tanzania. AFROHUN has been running for the last 13 years, influencing public health practice in these regions and ensuring the adoption of the One Health concept in universities, governments, and organisations.

This book chronicles AFROHUN's story in three parts. First, it examines the evolution and growth of partnerships over time. Second, it critically assesses the efforts and initiatives that AFROHUN has initiated or inspired across the continent and beyond over time. Thirdly, the prospects of One Health and AFROHUN reflect on how to sustain long-term outcomes

and impacts. The implicit questions drive this book:

1) What did AFROHUN set out to achieve, and how?
2) Is AFROHUN delivering results? Is AFROHUN fulfilling its promise?
3) How could the achievements be consolidated and sustained for the future?

These questions lie at the heart of development practice. The results-based management movement that started in the early 1990s requires a focus on the change that development initiatives bring about. Insights from organisational development scholarship show that as organisations implement their agenda, they also adapt to these outcomes and changing contexts. We thus consider how, through the pursuit of its development aspirations, AFROHUN has undergone internal changes. Within the partnership, we reflect on the changes at the individual, organisational, institutional, partnership and system levels. These categorisations are useful for holistically examining the multilevel nature of the AFROHUN initiative. This is evidenced by what is presented in the different chapters

In order to measure the success rate of AFROHUN, one could track the explosion of publications, projects, and programmemes evoking One Health or referring to AFROHUN or her predecessor, OHCEA I am sure the findings will lead to a simple but gratifying answer that AFROHUN has been remarkably successful. And if another approach was taken to track impact or outcomes, such as improved cost-effectiveness and reduction in the burden of disease, which ultimately is far more meaningful, though often more challenging and less immediate than quantifying outputs. The findings would be overwhelmingly encouraging. At the broadest level, though, evaluating One Health's success is still challenging. While an explicit definition of the goals of a health programmeme is crucial to demonstrating its impacts and effects (1), the recent promotion and adoption of One Health has demonstrated convergence around core competencies and capacities across the globe.

As we strive to demonstrate whether AFROHUN is meeting its promise, it is important to recognise the fundamental realities of development. First, evolution is part of life. An evolving, dynamic and complex environment demands adaptation to fit purpose and context. A growing organisation requires adequate capacity to meet these expectations. Long-term efforts require cultivating partnership and collaboration to generate multiplier effects and these have been strong cornerstones of AFROHUN.

Methods

The book development process has been a meticulous and collaborative effort involving the review of documents, reports, published work, and insights from implementers and One Health experts in Africa. Workshops were held to facilitate collective decision-making, review drafts, and ensure quality assurance. An editorial team was established to oversee the process. Additional data and insights were gathered during the 4th AFROHUN Conference in April 2024 in Nairobi, Kenya. Beta readers were engaged for validation and to provide additional inputs. The development of the book has been an iterative process, capitalizing on collective reflections and continuous learning.

Overview of chapters

The book is structured into three parts. The first part sets the scene and provides contextual information regarding the work of OHCEA and AFROHUN. It presents two chapters. Chapter 1 focuses on historical developments and current dynamics for One Health globally and in Africa. Chapter 2 reflects on the evolution of AFROHUN from its historical roots in LIPHEA and OHCEA. Part II, named AFROHUN in Action, focuses on the core areas of intervention, i.e., pre-service capacity building (Chapter 3), in-service capacity building (Chapter 4) and One Health research (Chapter 5). The last part reflects on the journey ahead. The design and prospects of AFROHUN's flagship intervention, the One Health Academy, are presented in Chapter 6. Finally, Chapter 7 reflects on the AFROHUN's journey, impacts, and contributions to inform the future directions.

Chapter one: One Health in Africa: historical foundations and current dynamics

This chapter focuses on tracing the status of One Health in Africa. Its coverage ranges from how Africa managed its health in the pre-colonial period and takes a quick sweep through the history of public health in Africa to the current period. It then transitions to the specific idea of One Health call it *"from the beginning…"*

While the phrase "One Health "is relatively recent, its underlying idea has been acknowledged for a significant period at national, regional, and global levels by early leaders in public health and veterinary medicine. Since the 1800s, researchers have observed parallels in disease mechanisms between animals and humans, even though the practice of human and animal medicine remained distinct until the 20th century. In recent times, the One Health concept has garnered unprecedented recognition within both public health and animal health communities. It is critical to understand the idea of One Health because the story of AFROHUN is, in essence, the story of the spread of One Health in Africa. AFROHUN has played a critical catalysing role in establishing and shaping One Health as an unavoidable discipline on the continent.

Chapter Two: Building a pan African One Health giant

As AFROHUN took its first steps, the challenge was to build bridges, that spanned not only geographic distances but also disciplinary divides. In this chapter, we explore the forging of connections between faculties of medicine, veterinary sciences, environmental studies, and public health who were previously siloed in their specialised domains. This led to a transformative outcome. The process of building bridges had to inclusive by extending beyond academia and embraced government ministries, international organisations, and grassroots communities. The goal was not only to share knowledge within the academic ivory towers but also to ensure that the benefits of One Health principles reached everyone possible.

Chapter Three: Building a field-ready one health workforce through innovative pre-service training approaches

AFROHUN was born out of university system and while there was a workforce in service that we would need to ground One health principles, establishing a robust One Health workforce through pre-service training became a very necessary venture for them to generate or build competencies and skills among the students that would join the field and influence the in-service as we built systems to formally impart the similar skills to the in-service teams. Pre-service training would be the mainstay of One Health which would involve equipping future professionals in disciplines such as medicine, veterinary science, and environmental science with a comprehensive understanding of the interdependencies between these domains. By integrating One Health competencies into the education of aspiring healthcare and veterinary professionals, a collaborative mindset that recognises the intricate relationships between human, animal, and environmental health is fostered. This approach ensures that future practitioners are well-prepared to tackle emerging infectious diseases, antimicrobial resistance, and other complex health issues that require a holistic and gratifying answer that and approach.

Building a One Health workforce through pre-service training not only enhances the effectiveness of individual practitioners but also promotes a collective and coordinated effort to safeguard the health of our planet and its diverse inhabitants. Pre-service training is the biggest jewel in AFROHUN's crown. The Network has innovated unique ways of working with students undergoing training in One Health-related professions. The chapter will delve into various approaches the Network has used in this regard.

Chapter Four: Retooling in-service workforce to match emerging capacity needs

This chapter focuses on the development of a One Health workforce through in-service training. Strengthening the One Health workforce through in-service training is a pivotal strategy for AFROHUN to enhance the capacity of existing professionals in various health-related fields. In-service training provides an opportunity for practitioners, including health professionals, veterinarians, and environmental scientists, to update their knowledge and skills in a manner that integrates the principles of One Health.

This targeted training equips them to understand better and address the interconnected nature of human, animal, and environmental health challenges. By fostering collaboration and communication across disciplines, in-service training cultivates a shared mindset that is crucial for tackling complex health issues such as zoonotic diseases and environmental threats. This approach ensures that professionals actively engaged in healthcare delivery, disease prevention, and environmental management are well-equipped to apply a holistic and collaborative approach, ultimately contributing to the overall effectiveness of One Health initiatives.

Chapter Five: Building the AFROHUN One Health collaborative research programmeme

Chapter five addresses in some detail the One Health Research and the steps AFROHUN has taken so far. The importance of One Health research in implementing One Health programmemes cannot be overstated, as it serves as the cornerstone for informed decision-making and effective interventions at the intersection of human, animal, and environmental health. One Health research provides the empirical foundation necessary to understand the intricate relationships between these domains, identifying shared risks, patterns of disease transmission, and environmental factors that contribute to health outcomes. This knowledge is crucial for designing and implementing comprehensive, as well as sustainable One Health programmemes that address emerging infectious diseases, antimicrobial resistance, and other global health threats. One Health research not only deepens our understanding of complex health issues but also lays the groundwork for effective and coordinated actions that can positively impact the health and well-being of different communities and ecosystems.

Chapter Six: The AFROHUN One Health Academy: consolidating progress, envisioning the future

The AFROHUN One Health Workforce Academy was designed to play a pivotal role in building a robust One Health workforce across the African continent. As a specialised training initiative, the Academy focuses on equipping professionals in health-related disciplines with the interdisciplinary skills and knowledge necessary to address complex challenges at the intersection of human, animal, and environmental health.

Through a combination of innovative curriculum development, collaborative research projects, and practical field experiences, the Academy fosters a holistic understanding of One Health principles. The impact of the AFROHUN One Health Workforce Academy will extend beyond individual capacity building, contributing significantly to the development of a skilled and collaborative One Health workforce capable of addressing the unique health challenges faced by the diverse communities in Africa and beyond.

Chapter Seven: Sustaining AFROHUN'S legacy to consolidate the One Health agenda in Africa

This chapter draws from the preceding chapters to cast a broader light on the future of One Health in Africa and the opportunities for AFROHUN to continue to shape that trajectory.

The emerging global and regional developments and attention to programmematic areas core to One Health, such as climate change, Antimicrobial resistance, urbanisation, politics and war, illicit trade and threats to the conservation and planetary health. The pursuit of an African-led development agenda espoused in Agenda 2063 and the New Public Health Order for Africa are strong foundations for AFROHUN to consolidate its role as continental champion of the One Health revolution. Forging strategic partnerships with

other One Health players will be critical to building synergies and harnessing efficiency. The role of African Governments won't lie at the periphery since One Health approach is the real future for pandemics, epidemics and indeed the potential emergencies like COVID-19, Mpox and many others currently scavenging Africa and some other parts of the world. One Health will continue to influence political and economic spaces since human and animal interactions have over time increased.

Who is this book meant for?

The target audience for this book includes the following:

1) Academics and Researchers: Individuals in the fields of public health, veterinary science, environmental science, and related disciplines who are interested in the One Health approach and its implementation in Africa.
2) Students: Particularly those studying public health, environmental science, veterinary medicine, and global health
3) Healthcare Professionals: Doctors, veterinarians, and other healthcare workers who may benefit from understanding the integrated approach of One Health.
4) Policy Makers and Government Officials: Those involved in creating and implementing health policies at local, national, and international levels.
5) Non-Governmental Organisations (NGOs) and International Agencies: Organisations working in health, environment, and development sectors that might be interested in collaborative efforts and outcomes in the One Health and Development arena.
6) Donors and Funding Bodies: Entities that fund health and development projects and may be interested in the impact and progress of the One Health and related development challenges.
7) General Public: Individuals interested in health, environmental sustainability, and collaborative efforts to address complex health challenges in Africa.
8) Managers leading teams responding to disease outbreaks and complex health challenges.

As I close, I applaud our backbone supporters including Prof Dennis Carrol, that without mentioning them here would not only be a gross omission but totally being very insensitive. Professor Japhet Killewo occupies a special place in the birth of this network, I do thank him for the passion and resilience. I take the opportunity to thank all authors, contributors, faculty, students and editors for whose participation, commitment and seal made it possible to see this come to fruition. Sincere appreciation to AFROHUN Development supporters/ partners; USAID, university institutions in the network, national and sub-national governments that have availed us protected space and conducive environment, as well as communities on whom we have experimented and implemented One Health innovative approaches and GIZ who have made this publication possible so as to avail it to many of us whom I take the opportunity to invite to pick your coffee, lean back and soak in our rich history, amazing achievements and our projections for the future.

Welcome and enjoy!!

PART I

Setting the scene

Chapter 1

One Health in Africa: Historical foundations and current dynamics

Aloysius Ssennyonjo, Simon Peter Alubbe, Irene Naigaga, Japhet Killewo, William Bazeyo

Introduction

Africa's health challenges are distinct and more severe compared to other regions. The continent struggles with a high incidence of infectious diseases such as malaria, tuberculosis, and HIV/AIDS, alongside a growing prevalence of non-communicable diseases such as diabetes and cardiovascular conditions (1,2). These health issues are compounded by broader determinants of health, such as food insecurity, malnutrition, poor sanitation, inadequate access to clean water, poor transport systems, poor housing and unfavourable livelihoods, particularly in impoverished areas (3).

Moreover, the healthcare infrastructure in Africa is under immense strain due to resource limitations. Shortage of healthcare professionals, insufficient medical facilities, poor health governance, inadequate data systems and chronic underfunding are significant challenges

(4). These factors create a highly complex and challenging healthcare landscape, making it difficult for African nations to effectively tackle their health problems and provide equitable,

quality healthcare.

The situation is further aggravated by recurring natural disasters, economic instability, and military conflicts in certain regions (3,5). Additionally, the continent's tropical climate and frequent interactions between humans, animals, and the environment in the quest for food and livelihood heighten the risk of emerging pandemics (6,7). Given these circumstances, it is no surprise that Africa's health indicators lag behind those of other regions, posing serious challenges to the continent's development prospects. These realities have brought focus to the One Health approach as a means to address complex and dynamic realities (8) comprehensively. The One Health approach draws the attention of researchers, policy makers, development partners and other stakeholders to the strategic actions and developments at global, regional, national and local levels required to holistically and collaboratively advance good health and well-being across the human, environment and animal spheres (8).

This chapter provides a comprehensive understanding of the One Health concept and its application in the African context, discussing the historical context, current dynamics, and future directions of One Health on the continent. The first section presents the concepts related to One Health. The historical context follows. The current aspects of One Health in Africa are presented, highlighting key developments, challenges, and opportunities for the future.

Overview of One Health Concept

Evolution of the One Health concept

There are many accounts of the origin and evolution of the One Health concept and practice (9–15). Dr Calvin Schwab, a veterinary epidemiologist, is credited for emphasising in his 1984 textbook, *'Veterinary Medicine and Human Health'*, the need for veterinary and human health professionals to collaborate to confront zoonotic diseases. He is credited with coining the term 'One Medicine' that later evolved into 'One Health' (16,17).

While Dr. Schwab takes the honours for introducing the term, the concept of One Health preceded him by more than a century or perhaps millennia back[1](16). In some narratives, the linkages between human and animal and environmental health are traced back to the early years of Greek Philosophers (18,19). Since the 1800s, scientists have observed that some diseases affect both animals and humans in similar ways. However, veterinary and human health fields remained separate disciplines. Several developments, such as the establishment of the US Centres for Disease Control and Prevention (CDC)'s veterinary public health division in 1947 and the founding of the World Health Organisation (WHO) in (1948), helped shape global public health, although the 'One Health ' concept—linking animal, human, and environmental health—was not yet mainstream (16,17).

The Wildlife Conservation Society introduced the modern concept of One World, One Health at a 2004 symposium in New York. The 12 Manhattan principles were adopted as

1 One of the most comprehensive time of evolution of OH is provided by Mackenzie et al 2024 (16)

major outcomes of that meeting, laying the groundwork for the 'One Health, One World' idea (20). This idea was further developed by six international organisations, who presented their joint Strategic Framework at the 2008 International Ministerial Conference on Avian and Pandemic Influenza in Egypt (13,17). The Avian Flu outbreak that began around 2003, affecting over 15 countries and leading to more than 700 human cases of H5N1, prompted a more formal adoption of the One Health approach (21,22). Since then, other international meetings and gatherings have taken place, and institutional frameworks have been adopted to institutionalise the One Health approach (9,19,23).

Defining One Health

Despite being a long-discussed concept in interdisciplinary and multisectoral circles, the push to turn One Health into actionable strategies has never been stronger. However, this has been hindered by multiple definitions of One Health that emphasise certain aspects of the approach and its principles driven by multiple actors and interests. One Health has been interpreted in various ways, resulting in numerous definitions across the literature and institutions. The Food and Agriculture Organisation of the United Nations (FAO), the World Organisation for Animal Health (WOAH), the United Nations Environment Programmeme (UNEP) and the World Health Organisation (WHO) through One Health High-Level Expert Panel (OHHLEP)[2] have worked together to mainstream One Health by providing a more harmonious definition (see Box 1 below)(18). The OHHLEP has also articulated One Health principles (see Box 2 below).

Box 1: The One Health definition developed by the One Health High-Level Expert Panel (OHHLEP) of the quadripartite

- *One Health is an integrated, unifying approach that aims to sustainably balance and optimise the health of people, animals, and ecosystems.*
- *It recognises that the health of humans, domestic and wild animals, plants, and the wider environment (including ecosystems) are closely linked and interdependent.*
- *The approach mobilises 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, acting on climate change, and contributing to sustainable development*

2 The One Health High-Level Expert Panel (OHHLEP) was launched in May 2021 in response to a proposal by the French and German Ministers for Foreign Affairs at the November 2020 Paris Peace Forum to four global organisations—FAO, OIE, UNEP, and WHO.

This definition focuses on tangible implementation, captured by the 4 Cs: Communication, Coordination, Collaboration, and Capacity building (see figure below).

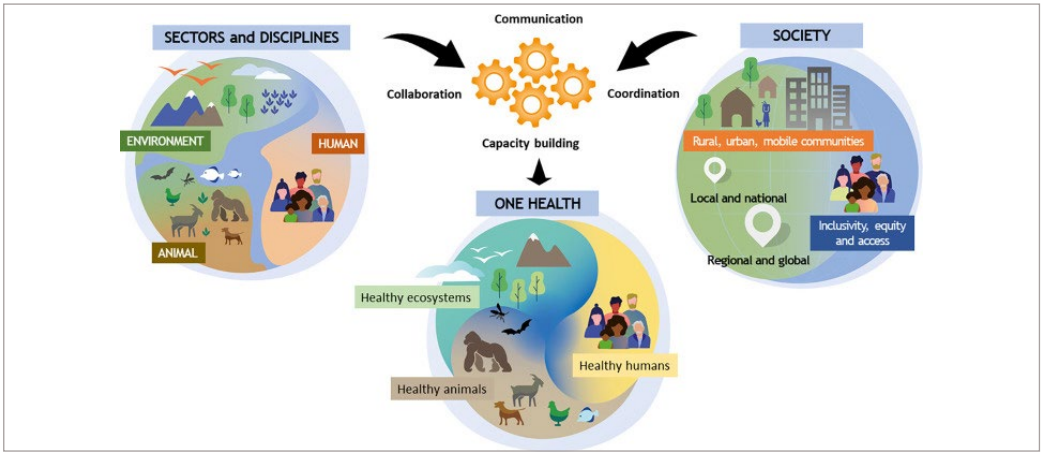

Figure 1.1: The 4 C's of One Health. Source (24)

The Principles of One Health

It rests on fundamental principles such as equity, It rests on fundamental principles such as equity, inclusivity, equal access, socioecological balance, stewardship, and trans-disciplinarity. These aspects are summarised in Box 2 below.

Box 2: Principles of One Health

- **Equity** across sectors and disciplines.
- **Socio-political and multicultural equality,** emphasizing that everyone deserves equal rights and opportunities, including the inclusion and engagement of communities and marginalised groups.
- **Socioecological balance,** aiming for harmony between human, animal, and environmental interactions, recognizing biodiversity, access to natural spaces and resources, and the intrinsic value of all living things.
- **Stewardship,** highlighting the human responsibility to adopt sustainable behaviours and solutions that respect animal welfare and the ecosystem's integrity, ensuring the well-being of present and future generations.
- **Trans-disciplinarity and multisectoral collaboration,** encompassing all relevant disciplines, integrating both modern and traditional knowledge, and representing diverse perspectives.

Source (24)

Scope of One Health

A common frame of thinking is expected to ensure that organisations and countries are better prepared to prevent, predict, detect, and respond to global health threats and

promote sustainable development (16) (see Box 1 above).

One Health is a conceptual extension of traditional public health thinking, approaches, and methodologies because it expands public health to link human, animal, and wildlife health with the environment to address the risks of global pandemics and of emerging and re-emerging diseases such as Marburg, Ebola, SARS and COVID 19. The One Health approach extends beyond zoonotic diseases and antimicrobial resistance to encompass prevention, health improvement, and health promotion. It embraces a comprehensive approach to health crisis management, including detection, preparedness, response, and recovery.

One Health now addresses a wide range of issues, including food safety, security, malnutrition, antibiotic resistance, and wildlife conservation. Furthermore, this definition aligns with and reinforces related concepts like Eco-Health, with its focus on the ecosystem, and Planetary Health, which stresses the importance of environmental and ecosystem well-being. This holistic approach can replace various interdisciplinary methods, such as Eco health, Planetary Health, Global Health, and Agri-health, to tackle complex health challenges comprehensively and improve health outcomes for all (24). Applicable at all levels, from local to global, One Health depends on robust governance, communication, collaboration, and coordination to identify co-benefits, risks, trade-offs, and opportunities, aiming for equitable and comprehensive solutions (24), pg 3.

Monitoring and evaluating these principles is vital to the definition's success. To facilitate monitoring and evaluation, the Network of Evaluation of One Health (NEOH) has defined the essential dimensions of One Health to include (1) systemic thinking, (2) holistic planning, and (3) transdisciplinary working, supported by an enabling environment to allow for (4) sharing, and (5) learning, endorsed through (6) a systemic organisation (14,25).

Overview of historical foundations of One Health in Africa

Although One Health is a fairly recent approach, the underlying principles and approaches are rooted in a rich historical past. In this section, we reflect on the evolution of health practice in Africa, considering the implications of current efforts to expand One Health on the continent. We acknowledge that the various stands of health under One Health (human, environmental and animal health) have largely evolved separately in silos. The legacies influence the current and future efforts to integrate the One Health approach in the research, policy and practice on the African continent.

We highlight the main features of the precolonial period, underscoring the evolving African a) way of life and livelihood integrated into the environment and b) understanding of disease and ill health, which has shaped interactions with the external influences and actors specifically linked to international trade at the time. The colonial period was characterised by health efforts to safeguard the health of the colonial rulers and develop politico-administrative systems that leveraged local elites and expertise. The 20th century involved advancements in biomedical sciences. An emerging understanding of disease causation influenced health promotion and disease prevention efforts. The birth of the World Health Organisation and the UN agencies shaped global health architecture and development efforts. State-building initiatives and attempts at government-led development characterised the immediate post-colonial period (26). Later, global reforms driven by international financial institutions and other forces of globalisation have shaped developments and dynamics at regional and national levels in Africa.

Pre-colonial and indigenous practices and knowledge systems

Historical narratives underscore traditional African practices and beliefs related to health and environment. They highlighted the co-existence and dependence of humans on the environment for livelihoods and survival (27,28). Early Africans were fruit gatherers and, later on, embraced hunting with the advent of the Stone Age. Over time, they domesticated some animals to provide food, security, and companionship. Communities close to water bodies embraced fishing as the main means of livelihood (29). Africans initially lived in small communities, which, over time, coalesced into chiefdoms and kingdoms with well-developed systems of governance, norms and values specifying expected individual and collective responsibilities and behaviours (29–31). Over time, critical skill sets (e.g., diviners, iron smiths, hunters, gatherers, farmers) were differentiated with clear means of passing on these capabilities from one generation to another. Archaeological information shows that over time, Africans embraced farming practices and various ways of food preparation with varied levels of sophistication (29). Early interactions with Western traders introduced new cultural influences, such as intermarriages and weapons like guns, food crops, and animals. Over time, the various aspects of African life, including food, culture, education, and marriage, became hybrid, showing characteristics of both local and foreign practices (32).

African conceptualisation of disease and therapeutic practices in the precolonial period evolved as well. There were similarities between Western and African healing practices at the start of the mingling between the Europeans and Africans (28). For example, diseases were considered to be caused by imbalances in the body systems, specifically fluids. There was also an appreciation of divine causes and remedies for diseases and ill health. Recourse to saints, miraculous cures and exorcisms were common in early Catholic ecclesiastical tradition. Healing practices included physical exercise or "changes in environments, climates and seasons" (28) pg 4.

However, transculturation and hybridisation of conceptions of disease and healing systems had limits, with scepticism and a sense of superiority, and the incompatibility of European and African healing systems is still prevalent today (28). There was also consideration of the climate as an underlying cause of diseases faced by European naval sailors and traders in the African setting. These diseases were linked to the tropical climate and distinctiveness to the temperate environments in Western countries. The underlying causes of the disease were perceived to be adverse heat conditions (28).

Health developments in Africa during the colonial period

According to Coghe, disease control and public health have been key aspects of social and political life in sub-Saharan Africa since time immemorial. With variations across space and time, many societies viewed disease as the result of imbalances in persons and institutions (28,33). They combined the use of *materia medica* from the natural world, spiritual divination, and community healing to redress these imbalances.

The spatial distribution of diseases meant that newcomers to Africa were particularly vulnerable to tropical diseases like malaria, to which the natives had developed immunity over time due to constant exposure (28,34). Similarly, Africans were particularly vulnerable to imported diseases such as tuberculosis. This dichotomy led to the racialisation of health and diseases. The tracking of deaths and diseases among European settlers, travellers and missionaries created an impression that Africa was "a white man's grave" (28).

The predisposition of Europeans to tropical diseases implied that health services that were thinly developed focused on protecting the health of the Europeans (28,32). The colonial powers, in some instances, preferred to use indirect rule by using African chiefs and elites as the main administrators of their power and control to minimise health risks (35). Relatedly, European missionaries found this context an attractive opportunity to extend religious beliefs alongside Western medicine to the African colonies (33).

Medical treaties and settler manuals contained recommendations for desirable lifestyles to stay healthy in tropical environments. These included avoiding direct exposure to the sun or health, covering the head, eating good food and wearing comfortable clothes, living in well-aerated spacious houses, avoiding swamps and forests, and preferring higher altitudes

(28). They dissuaded high manual labour and other risks to health. Other key developments included the use of quinine as prophylaxis against malaria- a term for tropical fevers before

it was discovered to be caused by plasmodium and transmitted by the female anopheles mosquitos (28).

The understanding of the role of the environment in shaping disease distribution and patterns inspired social segregation of neighbourhoods in African cities and societies (27,28). The European and colonial rules preferred communities and residences separate from the broader African society, which was considered a residual reservoir for diseases.

Sanitation practices such as draining swamps and avoiding overcrowded urban cities with decaying organic waste (28). Other practices included segregation of the sick and contagionist belief-inspired epidemic control measures such as quarantine, isolation and disinfection to address epidemic diseases like smallpox, cholera and plague (28,36). The bacteriological revolution in the late 19th century and the introduction of germ theory emphasised bacteria as causal agents for diseases. The novel understanding of diseases, innovation of diagnostic techniques and treatment modalities influenced advancements in the European and Western medical fields in the late 19th century. The invention of microscopy, laboratory systems, and the dissection of the dead changed the understanding of the causes of diseases (28). While mutual exchanges and adaptations still marked early encounters between African and European healing systems, the emergence of European germ theory-based biomedicine and the establishment of racialised colonial states in the 19th century increasingly challenged the value of African therapeutic practices for disease control on the continent (28,33,37).

Initially, colonial states focused on preserving the health of European soldiers, administrators, and settlers, who were deemed particularly vulnerable to the tropical climate and its diseases. Around 1900, however, they started paying more attention to diseases among Africans, whose health and population growth were now deemed crucial for economic development and the legitimacy of colonial rule (32). Fueled by new insights and techniques provided by tropical medicine, anti-sleeping sickness campaigns would be among the first major interventions. After World War I, colonial health services expanded their campaigns against epidemic diseases (28). They also engaged with broader public health approaches that addressed reproductive health problems and the social determinants of both disease and health (27,28).

Colonial states were not the only providers of biomedical healthcare in colonial Africa. Missionary societies and private companies had their health services with particular logic, methods, and focuses (33,34). Furthermore, after 1945, international organisations such as the World Health Organisation (WHO) and the United Nations Children's Fund (UNICEF) increasingly invested in health campaigns in Africa as well. Moreover, Africans actively participated in colonial disease control, most notably as nurses, midwives, and doctors (28,32). Nevertheless, Western biomedicine never gained hegemony in colonial Africa. Many Africans tried to avoid or minimise participation in certain health campaigns or continued to utilise the services of local healers and diviners, often in combination with particular biomedical approaches (28,38).

Post-colonial developments and health systems governance systems and the political economy of health

Post-independence state-building efforts sit at the core of post-independence health policies and their impacts (26,27). There was a focus on building the capacity to self-govern and provide social services as part of the social contract of the post-independence regimes and their citizens. As a result, many post-independent governments embarked on ambitious health policies such as health infrastructure development aimed at expanding access to healthcare (39). Government-led development programmemes were influenced by global health efforts such as the Smallpox Eradication Programmeme and the Alma-Ata Declaration of 1978, which advocated for primary healthcare (40,41)

A few decades later, the African state embraced systems of patronage and impersonal use of power, which greatly shaped how the state interacted with its citizens (42–44). Many African states have also embraced autocratic and undemocratic practices as presidents or the ruling elites aimed to stay in power (43). The impact of these policies has been mixed, with significant improvements in some areas but persistent challenges in others due to resource constraints and political instability. The historical legacies of colonialism, conflicts, wars, and apartheid have profoundly shaped the governance systems in many African countries (45,46). These legacies have often resulted in fragmented health systems and uneven development. Similarly, countries like Uganda and Rwanda have faced the aftermath of civil wars and genocides, which disrupted health services and infrastructure, making post-conflict recovery a significant challenge (47).

Despite advancements in human and animal health, the integration of veterinary and public health services is only a recent development in Africa (9,48). However, there is a longstanding recognition of the need for intersectoral action for health promotion (40,49). Recent initiatives such as the Global Health Security Agenda (GHSA) have promoted One

Health approaches in Africa to strengthen capabilities for disease surveillance and response (13,50). However, achieving effective collaboration requires overcoming institutional silos, enhancing cross-sectoral collaboration, and building capacity in both the veterinary and public health sectors (51,52). The political economy dynamic is still vital in shaping health development, state functioning and multisectoral collaboration for health (53–55).

Emergence and key milestones in the development of One Health in Africa

African ministers of health and environment showed early support for One Health by signing the Libreville Declaration at the first Inter-Ministerial Conference on Health and Environment in 2008 (12). This commitment was reaffirmed in 2018 at the third Inter-Ministerial Conference in Gabon, where they endorsed a 10-year Strategic Action Plan to enhance health and environmental interventions from 2019 to 2029 (12). The Africa Centres for Disease Control has also launched a One Health programmeme with a cross-disciplinary working group to coordinate disease surveillance, prevention, control, and epidemic preparedness, targeting antimicrobial resistance and zoonoses (56,57).

Efforts to advance One Health, spearheaded by regional bodies such as AFROHUN and the

International Livestock Research Institute (ILRI), have attempted to incorporate One Health principles into African health policies (12,58). Significant milestones in the development of One Health in Africa include the establishment of national One Health platforms, regional cooperation frameworks, and the integration of One Health principles into national policies to address health challenges holistically. Several countries such as Uganda, Cameroon, Kenya, Burkina Faso, and Tanzania have established One Health platforms to enhance multisectoral coordination and collaboration for health (59–61).

The adoption of the policy and research initiatives above have significantly propelled One Health efforts across Africa. A 2020 review by the International Livestock Research Institute

(9) revealed 315 One Health initiatives across 46 sub-Saharan African countries with 101 in East Africa, 85 in Southern Africa, 65 in Central Africa, and 64 in West Africa, with some projects spanning multiple regions. Nevertheless, national governments have provided minimal co-funding for these initiatives, with over 90% of the funding coming from external stakeholders (9).

The emergence of One Health frameworks and partnerships in Africa is closely linked to global efforts to promote an integrated approach to health by considering human, animal, and environmental health together (3,12). Its adoption in Africa has been driven by the continent's unique health challenges, such as the high prevalence of zoonotic diseases, which have driven the need for a One Health approach (62). International organisations such as the WHO, FAO, and OIE have played central roles in promoting One Health in Africa through various partnerships and initiatives. Regional players such as governments, regional economic blocks, partnerships, the African Union and Africa CDC have facilitated One Health through commitments to health security and the increasing recognition of the interconnectedness of health challenges (1,2). These regional efforts are crucial for addressing transboundary health threats and promoting sustainable development.

AFROHUN: A Champion for the OH Revolution in Africa

The Africa One Health University Network (AFROHUN) has emerged as a key player in advancing One Health workforce development, education and research in Africa (9,12). By fostering collaboration among universities, AFROHUN aims to build the capacity of future health professionals to address complex health challenges using a One Health approach (63). This initiative has been instrumental in promoting interdisciplinary education and research, which are critical for effective One Health implementation (64). This book focuses on these contributions, which are elaborated in the subsequent chapters.

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Health challenges in Africa that require One Health approach

Africa faces major health threats addressed by One Health (e.g., zoonotic diseases and pandemics). Between 2016 and 2018, over 260 infectious disease epidemics, disasters and other potential public health emergencies were identified in Africa, with 41 (79%) of the 52 countries in the region recording at least one epidemic during that period (12). In this section, we highlight prevailing issues that require a One Health approach and multidisciplinary collaboration.

Combating Zoonotic Diseases

Africa is home to a wide range of zoonotic diseases, which are illnesses that can be transmitted from animals to humans. Diseases like Ebola, HIV/AIDS, and various forms of influenza have their origins in animals, and the One Health approach has been instrumental in understanding, monitoring, and controlling these diseases (65,66). The Congo River/ Forest Basin has been shown to be one of the "Hot Spots" for emerging and re-emerging infectious diseases. For example, in the recent past, in Uganda alone, there have been outbreaks of Ebola, Yellow Fever and Anthrax (67,68).

Box 3: Case Study 1: Ebola Viral Disease outbreak in West Africa

The 2014-2016 Ebola outbreak in West Africa, particularly in Sierra Leone, Guinea, and Liberia, highlighted the significance of the One Health approach in managing infectious diseases (105,146). The virus is believed to have originated from bats, and the transmission to humans occurred through contact with infected wildlife and bush meat consumption. Efforts to contain the outbreak involved collaboration between human health agencies, veterinary services, and environmental experts (104,105). This integrated approach helped to trace the sources of the virus, prevent further spillover events, and implement strategies for managing both human and animal health. By applying the One Health approach, these countries successfully brought the outbreak under control and developed a strategy for preventing future outbreaks(104,105)

Case Study 2: Rift Valley Fever in Kenya

Rift Valley Fever (RVF) is a zoonotic disease that affects both animals and humans and is primarily transmitted by mosquitoes (126). In Kenya, the One Health approach was instrumental in controlling and preventing RVF outbreaks. Health authorities, veterinarians, and environmental experts collaborated to develop an early warning system that integrated meteorological and ecological data to predict outbreaks (126). By monitoring and understanding the environmental conditions favourable to disease vectors, authorities were able to issue timely alerts and implement strategies to mitigate the impact of RVF on both human and animal populations. This integrated approach not only saved lives but also helped protect the livelihoods of farmers by reducing the spread of the disease in livestock (126).

Wildlife Conservation

Conservation of biodiversity is a crucial aspect of the One Health approach. In Africa, the illegal wildlife trade and habitat loss threaten many species, leading to ecological imbalances (69,70). By promoting the protection of natural ecosystems, as well as understanding the interactions between human and animal populations, the One Health approach has contributed to successful wildlife conservation efforts. Conservation efforts in the Virunga National Park in the Democratic Republic of Congo exemplify this, where protecting gorillas has led to improved health outcomes for both the gorillas and local communities (71).

Similar results have been noted at Bwindi Impenetrable National Park in Uganda, which is home to a critically endangered population of mountain gorillas (72). Conservationists, public health experts, veterinarians, government, development partners, non-governmental organisations and local communities have adopted conservation efforts that reflect the One Health approach to protect these iconic primates and improve the health of neighbouring human populations (73). The approach involves monitoring the health of gorillas to prevent the spread of diseases between them and humans. Additionally, it focuses on community health and livelihood improvement to reduce human impact on gorilla habitats (73). By addressing both animal and human health within the same ecosystem, this approach has not only contributed to the recovery of the gorilla population but also improved the well-being of the communities living near the park. Continued co-existence is negotiated as wildlife at times destroys people's farms, threatening their livelihoods (73).

Food Security and sustainable agriculture

Africa faces numerous challenges related to food security, including crop and livestock diseases that can devastate agricultural economies. The FAO-WFP June 2024 Hunger Hot Spot report classifies the following African countries as hunger hot spots: Ethiopia, the Central African Republic, Mozambique, Nigeria, Sierra Leone, Zambia, Burkina Faso, Malawi, Somalia, and Zimbabwe (74). The One Health approach is pivotal in addressing these issues. By promoting a multipronged approach involving healthy livestock practices, monitoring foodborne diseases, and enhancing food safety standards, African countries have improved food security, as seen in Ethiopia's efforts to address the hunger crisis (75,76). Sustainable agriculture is crucial for ensuring food production while protecting the environment. By considering the interplay between agricultural practices, human health, and the environment, the One Health approach has played a vital role in promoting sustainable farming methods across the continent. Initiatives like the "Farmer Field Schools" in Kenya educate groups of 20-30 farmers on sustainable practices that reduce the use of harmful pesticides, promote ecosystem health and advance collaboration and experiential, hands on learning (77,78). The farmers meet regularly over during an entire production cycle – "from seed to seed, egg to egg, or calf to calf" (78). Based on the accumulated knowledge and skills, the farmers try out new ideas and "enhance their capacity to analyse and solve local agricultural challenges critically" (77,79). Farmer field schools focus on a variety of topics relevant to One Health, including crops, aquaculture, animal husbandry, forestry, land and water management and social issues. They also cover aspects of climate change adaptation,

gender and women's empowerment (77).

Access to clean water

Access to clean water is a fundamental aspect of public health. Many communities in Africa are affected by waterborne diseases due to the contamination of water sources by animal waste (80).

Multifaceted efforts underpinned by the One Health approach have been used to mitigate this problem through collaborative efforts that involve experts in human and animal health, along with environmental scientists (81). Development efforts that focus on improving water access and quality are critical to ensure the success of this approach.

Climate Change Adaptation

Climate change is a global challenge that disproportionately affects vulnerable communities in Africa (82). The One Health approach recognises the impact of climate change on human and animal health and the environment. The continental efforts recognise the multiple and complex interactions between climate change and aspects of One Health, such as pandemics, water access and availability, food security and conflicts (9,83).

One Health and Africa's development agenda 2063

Overview of Africa's Strategic Agenda

Agenda 2063 is Africa's strategic framework for achieving inclusive and sustainable development over 50 years, aiming to transform the continent into a global powerhouse by 2063. This initiative emerged as African leaders recognised the need to move beyond the focus on apartheid and political independence, which were the main concerns of the Organisation of African Unity (OAU), the precursor to the African Union (AU) (84). Instead, they prioritised goals such as social and economic development, regional integration, democratic governance, and peace and security.

In 2013, during the Golden Jubilee celebrations of the OAU/AU, African heads of state signed the 50th Anniversary Solemn Declaration, reaffirming their commitment to a new developmental path (85). This declaration marked a renewed dedication to the Pan-African Vision: an integrated, prosperous, and peaceful Africa, driven by its citizens and influential in the global arena.

The rationale for a 50-year development plan is rooted in several key factors: ongoing structural changes, increased peace and reduced conflicts, renewed economic growth, and social progress (86,87). It also addresses the need for people-centred development, gender equality, youth empowerment, and the opportunities presented by globalisation and the ICT revolution. Additionally, it capitalises on emerging development and investment prospects in sectors such as agribusiness, infrastructure, health, and education (86,87).

The African Union is organised into technical units responsible for focal areas of One Health, which are highlighted in section 1.4 above (88,89). For example, agriculture and rural

development are under the docket of the Rural Development Division, Agriculture and Food Security Division (88,89). There are also some relevant Specialised Technical Offices (STOs), namely the African Union Semi-Arid Food Grain Research and Development (AU- SAFGRAD), Inter-African Bureau for Animal Resources (AU-IBAR) and The African Union Pan African Veterinary Vaccine Centre (AU- PANVAC). Efforts have focused on enhancing agricultural productivity, promoting sustainable farming practices, and addressing the critical issues of food security and rural poverty. The Comprehensive Africa Agriculture Development Programmeme (CAADP) is the flagship programmeme on the continent "to help African countries eliminate hunger and reduce poverty by raising economic growth through agriculture-led development" (88,89). The CAADP also supports African states to strengthen resilience to climate change through the adoption of "disaster preparedness policies and strategies and early warning response systems and social safety nets". Other efforts include the development of the Digital Agriculture Strategy and its implementation Plan (2024 -2027) to foster the digital transformation of African agriculture. Other efforts focus on post-harvest and food safety, empowering youth and women in agriculture (88). Regarding the sustainable environment and blue economy agenda led by the Sustainable Environment and the Blue Economy Divisions, focus has been put on the following thematic areas: Biodiversity and Wildlife; Climate Change and Meteorology; Disaster Risk Reduction; Sustainable Land Management; Water and Environment (90). The Directorate of Sustainable Environment and Blue Economy recently coordinated the development of a comprehensive African Union Climate Change and Resilient Development Strategy and Action Plan for the ten years (2022-2033) (90). The Department also successfully convened the Africa Climate Summit in Kenya in September 2023 (82).

There are also the Regional Economic Communities (RECs), which are entry points for regional cooperation for One Health. These include the Common Market for Eastern and Southern Africa (COMESA), East African Community (EAC), Economic Community of West African States (ECOWAS), Southern African Development Community (SADC), Economic Community of Central African States (ECCAS), Intergovernmental Authority on Development (IGAD), Community of Sahel-Saharan States (CENSAD) and Arab Maghreb Union (UMA) (86).

Critical reflection of the significance of Africa's Strategic Agenda and One Health aspirations

Agenda 2063, as the continent's strategic framework, is highly relevant to One Health developments in Africa in several ways.

- Its emphasis on sustainable development, peace, and social progress aligns with the One Health approach, which recognises the interdependence of human, animal, and environmental health.
- By promoting inclusive and people-centred development, Agenda 2063 supports comprehensive health strategies that address socio-economic determinants of health. Moreover, the emphasis on youth and gender empowerment can enhance One Health's efforts by involving a diverse range of stakeholders and tackling health disparities.

- The 10-year implementation plans provide a structured approach for integrating One Health strategies into broader development goals, ensuring coordinated and effective health interventions across various sectors.

Agenda 2063 set out seven aspirations that reflect Africa's comprehensive vision for its future development (86,87). These aspirations are fundamentally aligned with the principles of the One Health agenda in Africa. We reflect on these interlinkages below.

- **Aspiration 1** of Agenda 2063 envisions a prosperous Africa based on inclusive growth and sustainable development. This ambition is directly relevant to One Health as it underscores the need for economic growth that respects environmental sustainability and addresses health disparities (91). Sustainable agricultural practices, efficient use of natural resources, and improved healthcare systems are integral to both economic growth and the One Health framework, which seeks to balance and optimise health outcomes across human, animal, and environmental domains (9,16).
- **Aspiration 2** aims for an integrated continent that is politically united based on the ideals of Pan-Africanism and the vision of Africa's Renaissance (87). The One Health agenda benefits from such political unity, which can foster collaborative approaches to health challenges that transcend national borders (44). Effective disease surveillance, control of zoonotic diseases, and management of shared natural resources require coordinated efforts across countries, aligning with the vision of a unified Africa (92).
- **Aspiration 3** focuses on good governance, democracy, respect for human rights, justice, and the rule of law (87). Transparent policies, accountability, and the rule of law are crucial for the successful implementation of One Health strategies such as epidemic and pandemic management (42,93). This governance framework supports multisectoral collaboration (87), which is essential for addressing complex health issues that involve multiple stakeholders, including governmental and non-governmental actors.
- **Aspiration 4** envisions a peaceful and secure Africa (87). Peace and security are foundational for the One Health agenda, as conflict can exacerbate health crises, disrupt healthcare services, and hinder disease prevention and control efforts (94). Stable environments allow for effective implementation of health programmemes and facilitate the collaborative efforts needed for One Health initiatives, such as addressing emerging infectious diseases and managing environmental health risks (95). War has undermined environmental conservation efforts in eastern DRC (96).
- **Aspiration 5** promotes a strong cultural identity, common heritage, shared values, and ethics (87). Cultural values and traditional knowledge systems can enhance One Health initiatives, as evidenced during the response to Ebola and COVID-19. Integrating local practices and community engagement into health strategies enhances their success (98). Respecting and incorporating indigenous knowledge can improve the acceptance and effectiveness of health interventions, particularly in rural and underserved communities (97,98).

- **Aspiration 6** aims for people-driven development, relying on the potential of African people, especially its women and youth (87). One Health Initiative can leverage this aspiration by involving communities in health decision-making processes and empowering women and youth as key actors in health promotion and disease prevention (60,99). Education and capacity building in health-related fields can also enhance local expertise and leadership in One Health practices (63).
- **Aspiration 7** envisions Africa as a strong, united, and influential global player and partner (87). A strong Africa can lead global efforts in One Health, contributing to international health security and participating in global health governance (100). By showcasing successful One Health approaches, Africa can influence global health policies and promote practices that benefit both the continent and the world (98).

In summary, the aspirations of Agenda 2063 align closely with the One Health agenda in Africa. This strategic agenda emphasises sustainable development, political unity, good governance, peace and security, cultural identity, people-driven development, and global influence (89). These elements are crucial for the holistic approach of One Health, which seeks to address health challenges through integrated efforts across human, animal, and environmental health sectors.

Africa's New Public Health Order

Africa's health aspirations are guided by the Africa Health Strategy (2). However, driven by the lessons learned from the COVID-19 pandemic, Africa's New Public Health Order, led by the African CDC and the African Union, was recently adopted (1). It aims to transform the continent's public health and health security landscape. This public health order focuses on building robust public health institutions, expanding the health workforce, enhancing local manufacturing of health commodities, increasing domestic resources for health security, and fostering respectful and action-oriented partnerships (1,4). It focuses on building resilient and self-sufficient public health systems across Africa capable of addressing complex health challenges, including pandemics (1,4). It aligns closely with the GHSA (50) by emphasizing self-sufficiency, resilience, and the integration of One Health principles.

About One Health efforts, the New Public Health Order aligns closely with the principles of One Health, which emphasises the interconnectedness of human, animal, and environmental health (16). For instance, strengthening public health institutions and workforce development contributes to better surveillance and response to zoonotic diseases, which are a core focus of One Health (101). Additionally, local manufacturing of health commodities ensures the timely availability of vaccines and treatments for both human and animal health issues.

The Africa CDC has been actively advancing One Health through various initiatives. For example, it collaborates with national public health institutes to enhance surveillance systems and has supported the development of One Health platforms in several African countries (102,103). These efforts are crucial for tackling health challenges at the human-animal-environment interface, such as Ebola, avian influenza, and COVID-19, which have significant implications for public health across the continent (1,4,57).

Spotlighting the emergence and re-emergence of epidemics in Africa

Overview of epidemics in Africa

Over the last two decades, nations worldwide have been grappling with an increase in emerging and re-emerging diseases at the human, animal, and environmental interface. The pathogens responsible for the emergence or re-emergence of these diseases can spread rapidly, not only nationally but regionally and globally. In 2014, the unprecedented Ebola outbreak in West Africa triggered a crisis that, for a period, seemed to evade effective national and international response, with catastrophic results for human health and wellbeing, food security, and economic prosperity (104,105). However, in 2019 came the worst pandemic ever. COVID-19 devastated the economies and health systems of all the countries of the world (106–108).

These epidemics are driven by critical factors within the African context that require a comprehensive strategy to anticipate and mitigate potential impacts on health aspirations on the continent (3,9,27,28). These factors include:

- **Geographical vulnerability**- regions like the Congo Basin and the Great Lakes are particularly susceptible to epidemics due to their tropical climate, which fosters a variety of pathogens and vectors. These areas are home to dense populations of insects and wildlife that can harbour and transmit diseases to humans, creating a "triple epidemic" scenario where human, animal, and environmental health risks intersect (3).
- **Geopolitical factors**, such as ongoing conflicts, wars, and political instability, exacerbate health vulnerabilities and undermine One Health efforts (3,96,109). The displacement of populations due to war leads to refugee crises, which are breeding grounds for infectious diseases (95). The destruction of healthcare infrastructure, combined with the movement of large populations, creates ideal conditions for disease spread. Furthermore, the politics of managing natural resources, like forests and wildlife, are critical. Human activities that disrupt these ecosystems can trigger zoonotic diseases, highlighting the need for conservation efforts and sustainable management at the human-animal-environment nexus (3,110). Illicit trade, including wildlife trafficking and the black market for animals, can facilitate the transmission of pathogens from animals to humans, complicating efforts to control outbreaks (69,111).
- **Globalisation and Transnational Threats:** Globalization increases the speed and extent of disease spread, making transnational health threats more prominent (112,113). Commercial determinants of health, such as the widespread use of antibiotics in agriculture, contribute to the rise of antimicrobial resistance (AMR), posing a significant challenge to global health security (114,115).
- **Population dynamics.** The African continent has a population of about 1.5 billion people. The UN projects that by 2050, Africa will have a population of 2.5 billion people. 25% of the world's population will be found in Africa (REF). Such a phenomenal

population growth will come with various consequences for development and One Health aspirations in Africa (3,89).

- First, there will be a need to settle and accommodate these one billion Africans. It is foreseeable that pressure on the environment and reserved areas such as forests and wildlife areas will be intense as people look for settlements. Secondly, these extra one billion Africans will need to be fed. This will be no mean task, considering that even today, Africa struggles to feed her people.

- There will need to be radical improvements in Agriculture, and the pressure on forests and areas reserved for wildlife will be even greater, leading to the encroachment of humans into wildlife ecosystems. This change carries the risk of a greater transmission of diseases from the wildlife ecosystem into the livestock and human ecosystem and may result in new epidemics and pandemics.

- The third challenge closely associated with population growth will be the effects of climate change brought about as more carbon dioxide is released into the atmosphere due to intensive industrialization to cope with meeting the needs of a bludgeoning population. Moreover, with forests likely reducing, this effect will likely be exacerbated.

The expected outcome of increased population will be a greater burden on the public health delivery system and ecosystems in Africa. Governments in Africa already struggle to provide sufficient healthcare to their populations. When the needs are almost doubled in the next 25 years or so, the pressure will be phenomenal. Furthermore, with the risk factors in the interaction between animal and human ecosystems growing, latent or new viruses could spring into life and cause epidemics and pandemics.

Evolving responses to emerging and re-emerging epidemics

In 2005, the World Health Organisation (WHO) developed the International Health Regulations (IHR), which provided a framework for the coordination of public health emergencies and improved the capacity of countries to assess and manage acute public health risks (116). The guidelines provided for the establishment of human-animal health coordination mechanisms and reinforced the One Health approach. In 2008, WHO adopted 20 key indicators for monitoring IHR core competency at the national level, with two specific One Health indicators (116). These were the establishment of a mechanism for coordination of all relevant sectors in the implementation of IHR and a system of surveillance of zoonoses and potential zoonoses. As the world adopted the One Health ideology, more voices began to promote the ideology of One Health as an effective way to manage human, animal, and environmental health in a coordinated manner.

From 2005 to 2006, facing the threat of highly pathogenic avian influenza H5N1, most African countries established multi-sectoral committees to help address the threat. When that threat was under control worldwide, and the disease-specific funding that supported these structures diminished or disappeared, these committees were disbanded. The institutionalisation of One Health in these countries is reflected in the establishment of

functioning, ongoing national One Health structures or "platforms". A National One Health Platform provides government and stakeholders with a mechanism to improve multi-sectoral coordination and collaboration to strengthen the prediction, prevention, detection of and response to emerging pandemic threats (48,59,117). With One Health being an internationally endorsed "best practice," an increasing number of African countries consider the One Health approach a key priority and are working towards the creation of One Health platforms.

Situating One Health efforts in Africa in a globalised world

The Global Health Security Agenda

The Global Health Security Agenda (GHSA) has increasingly recognised the importance of health security, particularly in light of emerging infectious diseases, bioterrorism, and the interconnectedness of health systems (50,59). The GHSA, which focuses on mitigating risks related to conflicts, terrorism, economic instability, and health crises, is closely intertwined with One Health developments in Africa.

Influences of Global Health Security Agenda on One Health developments in Africa

This agenda has facilitated, advanced, and inspired One Health efforts in Africa in several significant ways:

1) **Enhanced awareness and policy integration**

   The GHSA's focus on health security has heightened awareness of the need for integrated approaches to health threats that span human, animal, and environmental health. The global health security efforts have fostered policy development and cross-sector collaboration essential for One Health (118,119). The adoption of One Health policies at national and regional levels in Africa, has been driven by the understanding that health security requires a holistic approach. For instance, the African Union and its member states have been encouraged to adopt comprehensive health security strategies (57) that include disease surveillance, outbreak response, and the management of zoonotic diseases, all of which are core to the One Health approach.

2) **Strengthened health systems and capacity building**

   Global health security initiatives have facilitated capacity building in African countries, improving their ability to respond to health emergencies (101,120). Specific efforts have focused on strengthening surveillance and response systems. The emphasis on global health security has led to investments in surveillance and response systems across Africa (57). These efforts have supported One Health by encouraging the integration of veterinary and environmental health services with human health systems, thus enabling comprehensive monitoring and control of diseases like Ebola, avian influenza, and COVID-19 (9,63).

   Programmemes funded by the GHSA have provided training and resources to strengthen

laboratory networks, enhance disease surveillance systems, and develop rapid response teams (9,48). Training programmemes and capacity-building initiatives have equipped health professionals, veterinarians, and environmental scientists in Africa with the skills needed to implement One Health approaches (63,121).

3) Funding and technical support

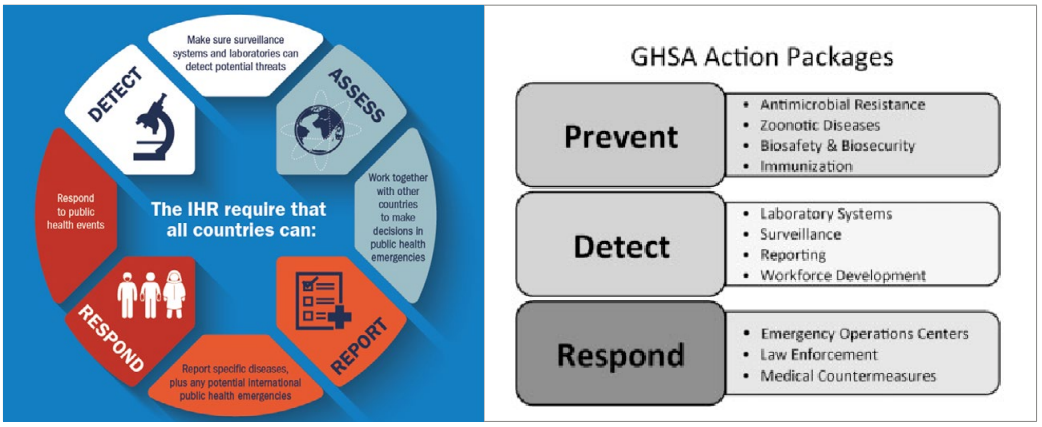
International funding and technical support provided under the global health security framework have been crucial in advancing One Health efforts in Africa (9). International donors and organisations, recognizing the link between health security and global stability, have funded programmemes aimed at improving veterinary services, laboratory capacities, and public health infrastructure. For instance, the World Bank and the United States Agency for International Development (USAID) have supported One Health projects that address zoonotic diseases, antimicrobial resistance, and other health threats that can impact both human and animal populations (122,123). These resources have helped African countries and networks such as Africa One Health University Network to build the infrastructure needed to monitor and manage health risks at the human-animal-environment interface (9,124).

4) Encouraging research, innovation and knowledge sharing

The GHSA has also spurred research and innovation in areas relevant to One Health (60,103,110). Funding for research on zoonotic diseases, antimicrobial resistance, and ecosystem health has increased, leading to better understanding and management of these issues. Collaborative research projects and information exchange platforms have enabled African scientists to contribute to and benefit from regional and global health knowledge (64,125,126). African researchers and institutions have been active participants in this global research effort. This has included research on disease transmission between animals and humans, environmental health impacts, and effective intervention strategies. Contributing valuable insights and innovations, the ongoing research strengthens the scientific basis for One Health policies and practices on the continent and globally (127).

In summary, the GHSA has significantly facilitated One Health efforts in Africa by promoting awareness, enhancing capacity, encouraging collaboration, providing funding, and supporting research. These advancements have strengthened the continent's ability to address complex health challenges at the intersection of human, animal, and environmental health.

Global Health Security Agenda and the evolving international and regional frameworks



The two images, obtained from the CDC archive websites, show the different components of the Global Health Security Agenda and the action packages. The images were accessed online on 9th August 2024.

The GHSA has played a significant role in shaping the frameworks and initiatives aimed at enhancing health security worldwide, particularly in Africa. This agenda is interconnected with several key mechanisms and agreements that collectively aim to improve pandemic preparedness and response, strengthen health systems, and ensure global health security. These include the Pandemic Fund, the proposed pandemic treaty, revised International Health Regulations (IHR), and Joint External Evaluations (JEEs).

1) **The Pandemic Fund**

   The Pandemic Fund, established by the World Bank, aims to support the development, procurement, and deployment of countermeasures and essential medical supplies (128). It is designed to provide low-income countries with the financial resources necessary to bolster their health systems and enhance pandemic preparedness (128). This fund is crucial for Africa to address financial constraints that often hamper timely and effective responses to health emergencies. The fund emphasises equity and aims to ensure that African countries are better integrated into global pandemic preparedness mechanisms. By supporting the local production of vaccines and other medical supplies, the Pandemic Fund contributes to the New Public Health Order's goal of expanding manufacturing capacity within Africa (1).

2) **Proposed Pandemic Treaty**

   The proposed pandemic treaty, currently under discussion at the World Health Organisation (WHO), seeks to create a legally binding comprehensive international framework for preventing, preparing for, and responding to pandemics (113). The treaty aims to enhance transparency, accountability, and equitable access to vaccines, diagnostics, and treatments (129). For Africa, such a treaty would ensure that the continent receives timely support and resources during pandemics, reducing the disparities seen during the COVID-19 pandemic. However, the politics of negotiation might undermine the treaty's final document and its binding authority (129).

3) Joint External Evaluations (JEEs)

JEEs are voluntary, collaborative processes to assess a country's capacity under the IHR to prevent, detect, and respond to public health threats (130). They help identify strengths and gaps in health security and offer recommendations for improvement. In Africa, JEEs have been instrumental in highlighting weaknesses in health systems and guiding investments to strengthen these areas (131). They foster a culture of accountability and continuous improvement, which is essential for effective pandemic preparedness and response. African countries have used JEEs to pinpoint areas requiring investment and development, which aligns with the New Public Health Order's focus on strengthening health systems and increasing domestic resources for health security.

Global Health Security Agenda and implications for One Health efforts in Africa

These institutional frameworks and initiatives above collectively support the One Health approach by promoting comprehensive and integrated health security measures. The Pandemic Fund provides financial support, while the pandemic treaty and revised IHR will create legal and operational frameworks for global cooperation, ensuring equitable access to health resources. JEEs offer a mechanism for assessing and improving national capacities, which is crucial for managing zoonotic diseases and other health threats. Africa's New Public Health Order is an effort to translate these global efforts into regional action. With its emphasis on institutional and workforce strengthening, local manufacturing, and resource mobilization, Africa's New Public Health Order creates a conducive environment for implementing One Health principles (1). Together, these elements enhance Africa's ability to prevent, detect, and respond to health threats, fostering a more secure and resilient health landscape on the continent. In summary, these instruments provide a supportive framework for Africa's New Public Health Order.

One Health efforts in Africa and the sustainable development agenda

At the dawn of the new millennium, global development aspirations were espoused under the eight Millennium Development Goals. These development aspirations were later replaced by the sustainable development goals in 2015 under the 2030 Agenda for Sustainable Development (132). The 17 SDGs and 169 targets are all linked to health directly or indirectly. SDG 3 focuses on advancing health and well-being for all. Universal Health Coverage (UHC) was adopted as the central concept around which global health development is advanced. However, in the context of One Health, it is vital to envisage the direct connection with other SDGs such as SDG 6 (water access), SDG 7 (Energy), SDG 11 (healthy cities), SDG 13 (Climate action), SDG 14 (Life on Land), SDG 15 (Life in water), SDG 16 (peace & just institutions) and SDG 17 (Partnership for development).

The SDG agenda has major implications. It envisages a complex and interconnected world with various actions required to ensure sustainable development. In this regard, one of the core SDG principles is the indivisibility that underscores the interconnectedness of this development agenda (132). Second, the SDG agenda emphasises the need for multisectoral and interconnected multidisciplinary action to manage interdependences and contribute to this ambitious agenda (133,134). The One Health approach draws on these interlinkages to advance a similar multi-factor and multisectoral approach. For example, globally, there is an increasing interest in One Health, multisectoral actions under SDGs, and the complexity of world problems (15,135).

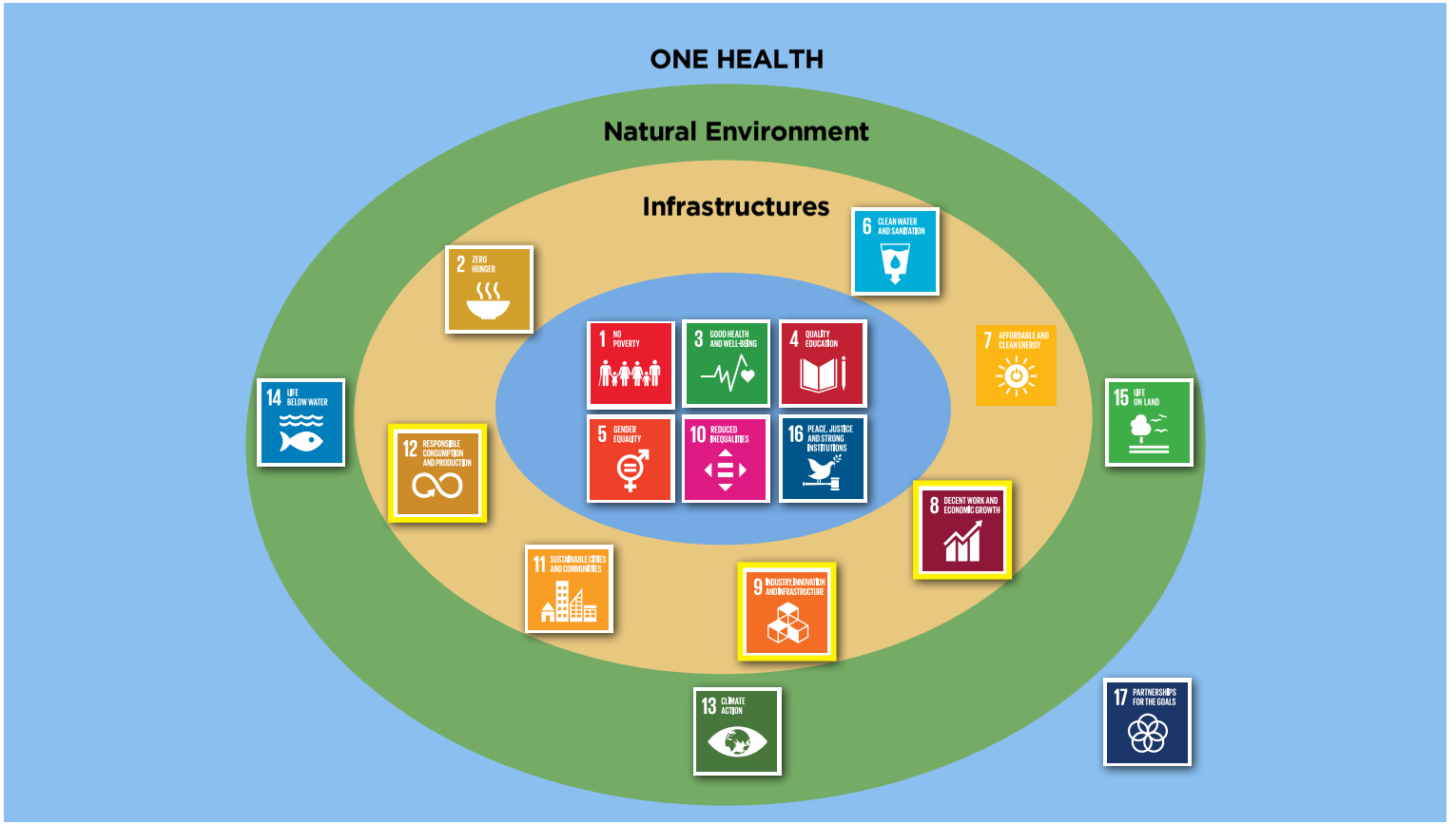


Figure 1.2: A framework grouping the SDGs based on their intended outcomes highlighting goals (in yellow) and agonistic relationships with other goals. Source: (136)

Global and regional partnerships for development: implications for One Health advancement in Africa

Relatedly, global development practice has engaged with questions on how best to promote equitable and productive partnerships to support the growth of countries and communities. South-South cooperation and triangular partnerships involving northern and south-south partners are increasing (137–139). In the context of the decolonisation discourse of development and public health, the role of southern partners in an international partnership is under increasing scrutiny. This development coincides with the changing aid landscape, which emphasises doing development differently. International legal and policy frameworks such as the Accra agenda and the Paris Declaration on aid effectiveness (52,140) also highlight critical principles that should characterise these donor-recipient country relationships. These efforts are expected to stimulate ownership, harmonisation and cooperative arrangements for development efforts. Increasingly, the SDGs highlight the need for domestic resource mobilisation to encourage prioritisation of local needs (141).

In developing settings such as Africa, it is also important to consider the increasing bilateral relationship beyond the Western development partners. For example, China, Russia and other countries have expanded their soft power through grants, loans and other forms of support to partner governments (142,143). These relationships take place within the context of a dynamic and complex geopolitical landscape under which One Health efforts are being pursued. The political economy factors also constitute the underlying structures that shape foreign policy and diplomatic pursuits of the different countries (144,145).

Chapter Summary

The One Health approach has emerged as a powerful tool for addressing the complex challenges that Africa faces in the 21st century. Coordination and collaboration across all levels of the human and animal health sectors, a One Health approach, has been essential to achieving the GHSA vision. It required a shift in every country's workforce culture and regulatory framework. Government ministries, industries, non-profit Organisations, and academic institutions worked together to achieve a stronger and more effective public health system, from the first responders on the front line to the policymakers implementing change. Universities were the key drivers of One Health change as they educated the future One Health workforce and forged partnerships with governments and communities to support decision-making through action research, analytic tools, and service work. This chapter has laid a strong foundation for the rest of the book by covering the conceptual issues, the historical foundation, and the current dynamics shaping One Health on the African continent. Unpacking these realities is important to understanding AFROHUN's influences on One Health for more than a decade. In the last chapter, we revisit some of the issues raised here to inform the strategic direction for AFROHUN and One Health efforts on the continent.

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CHAPTER 2

Founding AFROHUN: Building a pan African One Health giant

William Bazeyo, Japhet Killewo, Sarah Nitumusiima, Diana Muta Njambi, Berhe Gebretsadik, Immaculee Katengwa, Simon Peter Alubbe, Nina Ainembabazi

Introduction

In September 2009, when the Africa One Health University Network (AFROHUN) was founded as OHCEA (One Health Central and Eastern Africa), the concept of a One Health approach in public health was hardly heard of, and very few institutions practised it. However, the concept of One Medicine seemed slightly more understood by some higher education Institutions worldwide (1).

As highlighted in Chapter 1, the acceptance of the concept of 'One Health' has progressively increased in Africa as a strategy in public health practice, especially after the containment of the avian flu epidemic, which affected several countries (2–4). However, in 2010, when The Africa One Health University Network (AFROHUN) was founded as OHCEA (One Health Central and Eastern Africa), this concept got a new, powerful, and well-established champion (5). OHCEA started with lead Institutions like Makerere University School of Public Health and Muhimbili University of Health and Allied Sciences (MUHAS)in Tanzania, Kenya, Ethiopia, DRC, Rwanda and Uganda. From the onset, this establishment was funded by USAID. It quickly set up structures in Central and Eastern Africa. It later expanded to 26 institutions in 19 universities, in 10 countries. The institutions are schools of public health, medicine, veterinary medicine, environmental science and pathobiology. This growth was rapid and took place over just 13 years (6).

This chapter traces the triggers and initiatives that led to the formation of OHCEA and the various milestones along the way. It will delve into the roots of OHCEA by looking at pre-OHCEA years when the initiatives of LIPHEA (Leadership Initiative for Public Health in Eastern Africa) and The Health Emergency Management Programmeme (HEMP) Alliance were launched and activated between 2005 and 2010 to enable better coordination of the public health sector in Eastern Africa and build the capacities of practitioners in leadership and public health practice (7). Along the way, OHCEA outgrew its initial mould of focus on Eastern Africa and spread to West Africa, necessitating a relaunch and a renaming to AFROHUN. Throughout the rest of this chapter, AFROHUN will refer to both OHCEA and AFROHUN unless the context specifically requires the use of the older name (8).

AFROHUN shows no signs of slowing down in its growth as it seeks to attract more players from around Africa to join the network and create a sustainable and lasting impact in training the one health workforce in Africa that is 'epidemic and pandemic ready'. The story of AFROHUN is, therefore, an ongoing story of how an African initiative in public health can make a real difference in the provision of Health on the continent.

AFROHUN did not happen in a vacuum. Some dedicated people conceived great ideas, incubated them through a shared vision with various stakeholders, and delivered a product that now attracts admiration and attention from around the public health universe. The foot soldiers also implemented a humongous idea, often amidst an intense interaction of cultures, languages, and systems, as they sought to mould different universities from various parts of Africa into a cohesive whole. This chapter is written by these historical figures drawing from their own recollection. We complemented by reports and documentation of the process over time.

The need for competent public health leaders: The birth of Leadership Initiative for Public Health in Eastern Africa (LIPHEA) and the HEALTH Alliance

Contextual issues

In 2005, USAID identified a gap in the leadership capacity of the health service delivery system in the East African region. Dr Dennis Carroll, then USAID's head of the Emerging Pandemic Threats Programmeme, noted that while the medical and public health training institutions in the area had built substantial capacity for managing primary healthcare services, there was a glaring gap in leadership skills in public health leadership (7,9). This gap presented itself in the following ways. First, hospitals would run out of supplies at critical times to manage epidemics, indicating poor supply chain planning. There seemed to be little planning and anticipation of public health emergencies and epidemics, and when they happened, there was a sense of a reactive approach rather than a proactive one. Secondly, the challenges were not just limited to supply chain management but extended to human resources and budgeting. Clinically, practitioners were professional and competent, but as soon as doctors were appointed administrators of hospitals or regions, these gaps in management skills would come to the fore and lead to inefficiencies.

Moreover, when there were such public health emergencies, the quality of coordination and information sharing amongst response teams was wanting, leading to more extended periods required to bring epidemics under control. Then, there did not seem to be clear protocols for engaging with other stakeholders during public health emergencies. Further, intercountry coordination was ponderous and bureaucratic, costing much time and requiring time to control outbreaks. The region, therefore, needed health managers with leadership skills to identify challenges and develop innovative interventions to address them (7,10).

Around 2005, Africa was found to be overwhelmed by different types of health problems due to largely preventable factors. It had the highest maternal and child mortality in the world. In addition, malaria continued to be a major killer, especially of pregnant women and children under five years of age, despite public health interventions against it. New diseases such as HIV/AIDS, which had emerged a decade earlier, created enormous complexities in managing African healthcare systems and in reaching populations most in need (11).

A lack of practical leadership skills among health and other public sector professionals worsened the situation. It demanded changes in how practitioners and policymakers viewed public health and healthcare provision. Lack of leadership in the health system of Africa was therefore identified as a major problem that prevented the achievement of good health. It was also observed that most middle- and higher-level leaders in the health systems of Africa were products of public health schools, but most lacked leadership skills (12).

Therefore, leadership was believed to be part of their curriculum by improving the leadership component in the health management modules of undergraduate and postgraduate education systems in medical schools and universities of health sciences (7). The product of such training would be expected to use such skills towards reducing community morbidity and mortality through high-quality services. In addition, there was a need to develop short courses targeting important stakeholders in addressing health challenges through regular training programmemes for pre-service and in-service personnel.

Founding LIPHEA and the HEALTH Alliance

In response to the challenges above, in 2005, USAID launched a call for the 'Leadership Initiative for Public Health in East Africa'. Dr. Dennis Carroll was the Director of the USAID Pandemic and Other Emerging Threats Unit. In this position, he led the USAID Emerging Pandemics Programmeme, a global effort to combat new disease threats before they could become significant threats to human Health. The purpose of this call was to put together a strategy to address the leadership gaps that had been identified. USAID was keen to receive proposals on how such challenges would be addressed (7).

This call interested the deans of two schools of public Health in East Africa at the time. These were Prof. Leshabiri Melchizede from the School of Public Health of Muhimbili University College of Health Sciences, Tanzania, and Prof. David Serwadda from the Institute of Public Health of Makerere University, Uganda. The two teams resolved to present a joint response to the call, and the team in Uganda invited the team in Tanzania for reciprocal meetings to develop an attractive proposal for USAID. During those meetings, two leaders, Dr. William

Bazeyo and Prof. Japhet Killewo, representing Makerere University in Uganda and Muhimbili University in Tanzania, respectively, were nominated to lead the proposal development process. The proposal was completed and submitted to USAID, winning the acceptance of many African universities that applied (7,9).

Following the proposal's success, Makerere University Institute of Public Health and Muhimbili University College were tasked to select two universities in the US with which they would collaboratively implement the project. It was envisaged that a collaboration between the winning bidders and the US universities would create a partnership and linkage for exchanging ideas and approaching the identified challenges with the benefit of learnings and experiences from the American universities.

Six American universities pitched to the two African institutions about their contribution to LIPHEA if they were allowed to lead. Most travelled to the two East African institutions to showcase their capacities, what they would bring to the collaboration, and how working with them would add value to the project. The prospect of collaborating with African universities to enhance public health leadership in Eastern Africa appealed to the Americans for the following reasons:

- There was an opportunity to expose American students to new perspectives and ideas in Eastern Africa.
- The re-establishment of ongoing and continuing global links.
- The enhancement of the American faculty knowledge and capabilities.
- Expansion and improvement of the reputation of American institutions.
- Opportunities for joint research and student and faculty exchange programmemes.

The lead teams from the two East African universities were then invited to participate in an open selection for the US university partners in a meeting convened by USAID. After lengthy negotiations and a secret ballot, John Hopkins University was selected to lead the collaboration with Tulane University. Prof Gilbert Burnham of Johns Hopkins Bloomberg School of Public Health and Prof Nancy Mock of Tulane University in New Orleans, USA, represented the US partners. After the above process, LIPHEA was conceived as a pioneering initiative of the public health schools in the region that focused on building leadership capacity for improved health service delivery in the area.

Initially, LIPHEA was funded by USAID through the Higher Education for Development (HED) Fund with the aim of training managers who could lead and impact the high morbidity and mortality levels in the East African region and strengthen effective public health leadership for Uganda and Tanzania (7,9). In 2005, LIPHEA developed a second proposal to improve ICT infrastructure and capacity to support the training of leaders in East Africa and create a Regional Centre of Instructional Excellence. This proposal was also successful.

Finally, in 2007, LIPHEA won another grant to implement the 'Health Emergency Management Project' funded by USAID and the Rockefeller Foundation. The goal of HEMP was to build capacity at the district level in member countries to manage and respond to health emergencies using an 'all hazard' approach. This included the emerging threat of

the Pandemic Avian Influenza (AI). Over the years stretching to 2010, LIPHEA grew to become a consortium covering seven public health schools in six Eastern African countries: Uganda, Kenya, Tanzania, Rwanda, the Democratic Republic of Congo, and Ethiopia. The consortium became known as the HEALTH Alliance, and it replaced LIPHEA. Through this new consortium, several activities were implemented, with considerable results in building the health leadership capacity of the participating countries and institutions. The funding for all these initiatives came from USAID and started at USD 5 million in 2005, growing to USD 7.5 Million by 2010 (7).

The call that led to the establishment of LIPHEA, which later morphed into the HEALTH Alliance, had a clear theory of change to address the identified leadership gaps in Eastern Africa's public health sector. It envisaged sharing knowledge and experiences from the older and more established American universities with the newer Eastern African universities. The mentoring relationships would also create points of reference for the African institutions as they improved various aspects of leadership training in their curricula. It was also envisaged that experiential training in the field would provide a real-life context for managing epidemics and other public health emergencies. The initiatives created to deliver these outcomes relied on the holding of regular training and mentoring activities, exchange programmemes with universities in the USA where competence in public health leadership and collaboration was ahead of what was obtained in East Africa, and field activities to implement what was learnt in seminars and workshops (7).

LIPHEA and HEALTH Alliance pursued their objectives using various methods. First, training was a critical methodology. At LIPHEA and the HEALTH Alliance, work typically involved formal short courses following a curriculum, a common approach adopted across member countries of the HEALTH Alliance—this curriculum, developed in collaboration with American universities, aimed to provide a structured learning experience. Then, fieldwork emerged as a natural extension of the training curriculum, offering learners practical, hands-on experience in real-life public health situations. These field experiences served to solidify the theoretical concepts introduced in the training modules. The challenges encountered in the field closely mirrored those found in actual public health workplaces, effectively instilling practical skills and approaches to managing disease outbreaks (7).

Exchange programmemes were established to improve educational sharing further. Faculty from participating US universities visited Eastern African universities, facilitating the exchange of insights and experiences in training public health professionals. Reciprocally, faculty from Eastern Africa visited American universities to glean from their counterparts' experiences and processes (7). Complementing these initiatives were workshops and conferences organised by LIPHEA and the HEALTH Alliance across the Eastern African region. These events provided valuable platforms for networking, engagement, and knowledge sharing. Specifically, they proved instrumental in sharing public health leadership and management innovations. The insights gained from these workshops and conferences often found fuller development in subsequent formal training sessions and experiential learning opportunities. The funding for all these initiatives came from USAID and started at USD 5 million in 2005, growing to USD 7.5 Million by 2010.

The achievements of LIPHEA and the HEALTH Alliance

The establishment of the HEALTH Alliance marked a significant milestone in the realm of public health in Eastern Africa. It was then that comparative studies were conducted to establish the capacities of the different schools. The aim was to level the ground for the scholars in the region in public health. Together with the curriculum review, it was agreed to create a database of the specialities in the region, such as health economists and statisticians, so that schools could work with them as the need arises. These experts would also serve as external examiners at these institutions (7,9,13).

Deans, faculty members, government ministers, and district-level officers collaborated across disciplines and countries to develop and implement crucial curricula. Sustained by additional grants and projects, the HEALTH Alliance played a pivotal role in initiatives such as the RESPOND project by USAID, utilising the alliance as their African Hub for epi-zoonotic disaster response training. Furthermore, the DFID-funded Future Health Systems consortium operated through the HEALTH Alliance as a hub to enhance Health Systems Research in the region.

Staff of Makerere University, Muhimbili University of Health and Allied Sciences, and partners pose for a group photo after a LIPHEA meeting at Makerere University School of Public Health (Makerere University Institute of Public Health then) in 2007. Source: AFROHUN Secretariat archives.

Beyond providing multidisciplinary curricular support, the HEALTH Alliance fostered collaboration among experts from different countries. During crises like the Bududa landslides in Eastern Uganda and the Kenyan post-election riots in 2007, members from one country supported another, demonstrating the strength of relationships built on professional trust and mutual respect among the deans of the HEALTH Alliance schools. These connections persisted beyond the LIPHEA grant, with ongoing efforts to secure

funding and opportunities for continued collaboration and maintenance of the established network.

The Health Emergency Management Programmeme (HEMP), another success, established a crucial link between universities and districts. This initiative facilitated the sharing of knowledge from esteemed urban institutions with districts, which had previously been used primarily for research rather than developing impactful programmemes (7). Workshops brought together professionals from various districts, strengthening the network through collaboration and cross-context learning despite the differences in their mandates. Policy influence was notable, particularly at the district levels across the six countries, with HEMP training continuing through additional funding from the United Nations Office for the Coordination of Humanitarian Affairs (OCHA), The Rockefeller Foundation, and UNICEF—a testament to the lasting impact of LIPHEA (7).

Although currently not in publication, the East African Journal of Public Health served as a valuable outlet for sharing knowledge, innovations, and experiences in Africa and beyond. Accessible through platforms such as African Index Medicus, African Journals Online, Bioline International, PubMed, and CABI Global Health Abstract Database, the journal's articles remain relevant and available for learning and reference (7).

The birth of OHCEA: Capitalising on what was learned from LIPHEA

Context and rationale

It was apparent that LIPHEA and the HEALTH Alliance had not anticipated dealing with the broader challenges that a public health practitioner faced when dealing with a pandemic, an epidemic, or other public health emergency. LIPHEA and the HEALTH Alliance were purely for public health professionals, yet many pandemics and epidemics involved other specialties such as animal medicine and environmental science. Learning from the control of the Avian Flu epidemic that affected several African countries, zoonoses such as Avian Flu required closer collaboration between human and animal health specialists as they interacted with the environmental habitation of the causative pathogens and hosts (9).

USAID recognised the need to bring on board Veterinary schools in each country invited to participate. This development was welcome but would later be an uphill task as it was looked at: "Who would lead now?" Vets or Medics! Each school of Public Health was requested to identify a school of veterinary to partner with in their country, which was done successfully except for Kenya, which brought on board two of each because of University differences and local politics. This was accepted as the team sought solutions with USAID's support. It would be a legal corporate body hosting projects and initiatives, including LIPHEA and Others. After a long discussion, the board agreed on One Health Central and Eastern Africa (OHCEA) (9,14). The OHCEA Secretariat was established in Uganda, in 2010. The network was born to respond to emerging complex challenges in the public health sector. Membership was extended to schools of veterinary medicine in the Eastern and Central African region to form what became known as **One Health Central and Eastern Africa**

(OHCEA). The body was started as autonomous, not belonging to any member institution. The articles of memorandum of association were prepared and signed by the then deans of the participating institutions. MakSPH was requested to host OHCEA until it found a home soon after.

USAID and champions facilitated a historic meeting with participants drawn from seven schools of public Health, seven schools of veterinary medicine and the two American partner universities (Tufts University and University of Minnesota) in addition to 'RESPOND project staff' to inaugurate OHCEA (15). The network was later incorporated as a company limited by liability on the 24th of June 2011. The core domains of action are workforce development, institutional capacity development, and partnership and engagement (9,16).

As noted already, the consortium name was initially coined to reflect the organisation's membership from Central and Eastern Africa. Later, as the organisation grew to cover other parts of Africa, the name was changed to AFROHUN. The change in name was inspired by several drivers including a) growing need to expand to other parts of the continent, b) need to expand the network's scope of engagement beyond traditional disciplines of human and animal health to include forestry, agriculture, business at national, local and international levels; c) connecting with the outside world beyond the universities to include policymakers, private sector, businesses, civil society, and communities, and 4) affirming AFROHUN's niche in One Health workforce development (8,13).

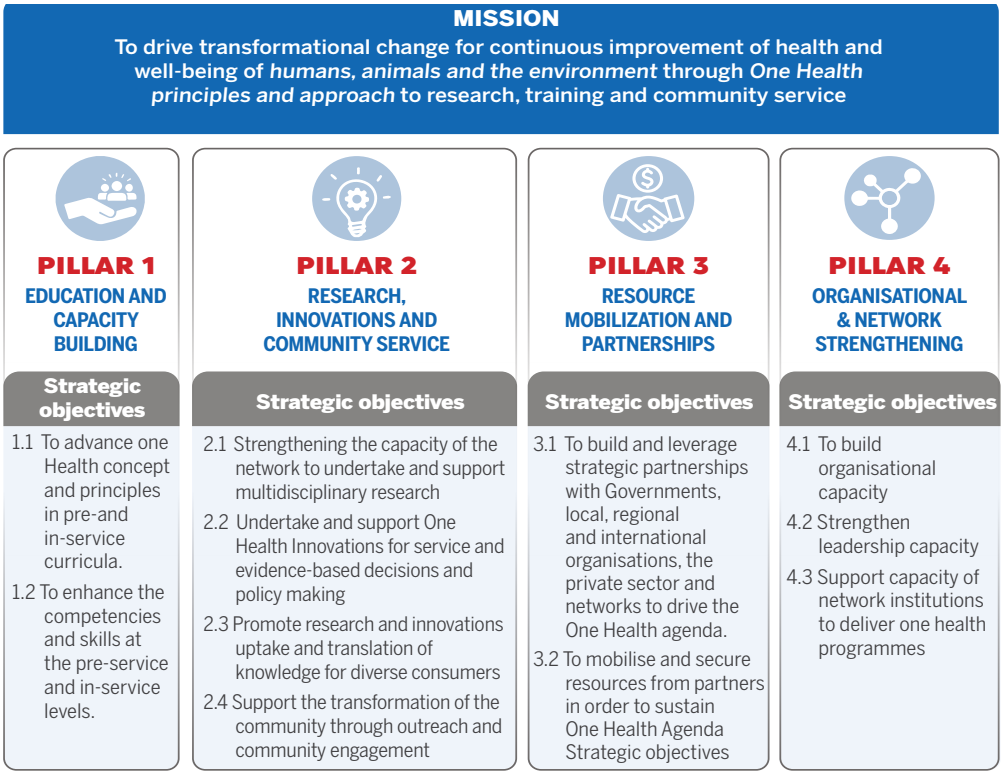

Figure 2.1: AFROHUN's approach to workforce development (8)

Strategic foundations for OHCEA: Striving to become a thriving panafrican One Health Organisation

Deans, Directors and Principals of the original OHCEA member institutions take time off to pose for a group photo after signing MoUs. In the photo, they each show off their copies of the MoU. This was in 2012 in Kampala, Uganda.

AFROHUN took up a formidable challenge in creating a Pan-African public health network. This is because Africa is a vast continent with many challenges, making such an endeavour a considerable undertaking. These aspects are elaborated in Chapter 1. However, we highlight these issues here for re-emphasis and proper contextualisation of the AFROHUN story. The context of Africa is one of a complexity of languages and cultures, a hangover of colonial power structures and cultures, and a competition between African countries and institutions positioning themselves in the competitive global marketplace of ideas, products, and systems (17,18). A deeper look into these challenges and contexts is helpful.

First, Africa is a continent of 54 countries with just over 1.5 billion people. There are between 1000 and 2000 languages spoken in Africa. The continent is home to one-third of all the world's languages. In total, there are at least 75 languages in Africa, which have over one million speakers. However, the continent uses languages mostly adopted from the former colonial powers when it comes to business and official communication. These are English (21 countries), French (29 countries), and Portuguese (5 countries). Three Indigenous languages have become official or business languages. These are Arabic (17 countries), Amharic (one country), and Kiswahili (four countries). Bringing African countries into any union means navigating this labyrinth of languages.

Secondly, Africa is a vast continent with slightly over 30 million square kilometres spread over six time zones. Africa time zones range from UTC/GMT -1 to UTC/GMT + 4. A country

like the Democratic Republic of Congo, one of the member countries of AFROHUN, has two time zones. Setting up a pan-African organisation necessitates travel across this vast continent, where air connections are at best limited. Virtual meetings straddle the various time zones, bringing into play the challenges of working beyond normal working hours for some network members.

Thirdly, Africa's colonial hangovers cannot be wished away. Ghana was one of the earlier African nations to get independence 66 years ago. Since then, all the 54 nations of Africa have gained independence, although two, Ethiopia and Liberia, were never colonised. The various colonial powers set up administration and governance systems that affected every facet of life, including public health systems and universities (19,20). When the African nations gained independence, most continued with the policies and systems the colonial powers had left behind. Many years later, with changes effected by various governments, differences and approaches remain in public health practices, roles, structures, and university training programmemes. As discussed later, weaving a Pan-African organisation through these contexts became AFROHUN's task and challenge.

With this context in mind, AFROHUN invested in youth training as a critical pillar of their capacity development actions. This youth focus was done in two significant ways. First, by introducing One Health concepts in university curricula, human and animal health professionals in training are exposed to the idea even before they step out to practice. Secondly, AFROHUN introduced the Students One Health Innovation Clubs (SOHIC), which enabled students to meet and interact with each other while performing One Health-related activities such as field visits or One Health competitions (13,21,22). These clubs bring together students from different disciplines, becoming a signature programmeme for AFROHUN. They get involved with community projects and programmemes. These activities are elaborated on in Chapter 3.

Against that background, the overarching goal of OHCEA/AFROHUN was to create a more resilient human resource foundation for one health effort. This entailed not only the training of the workforce but also a concerted effort to enhance worker performance. By addressing both aspects, the initiative sought to build a sustainable and adaptable workforce capable of effectively managing the complexities of public health challenges in the participating countries. The following objectives were adopted.

1) Strengthen a growing institutional network in terms of leadership, governance, technical assistance, and information-sharing across countries to transform ourselves to deliver One Health.
2) Support national agencies in building capacity and efficiency for surveillance, reporting systems, and outbreak response in the country and across borders.
3) Provide pre-service, in-service and community education, training, and outreach to expand the size and capabilities of the One Health workforce.
4) Build and leverage strategic partnerships with other organisations and networks for mutual awareness and benefit.
5) Strengthen infrastructure capacity (Laboratories, Information Technology, Human resources) and facilitate resource sharing to support One Health.

6) Generate evidence-based data and share state-of-the-art information to advance training, science, and practice and inform policy.

As indicated earlier, OHCEA was primarily an east and central regional network, as the name suggests, and there was again a need to expand it after realising that problems that needed a similar approach were aplenty in other countries. It was partly the desire of the funders, to get on board countries especially in West Africa, hence the invitation to Senegal and Côte d'Ivoire institutions to join the network. The other driver was AFROHUN management wanting to spread this expertise further deeper into the continent. Hence, the name-change to AFROHUN. .

Why OHCEA was started as a university network

As mentioned above, the collaboration's overall goal under OHCEA/AFROHUN was to enhance One Health policy formulation and implementation and contribute to countries' improved capacity to respond to emerging pandemics in the region. The network's vision was then formulated to guide operations and innovations. **The vision is to be a global leader in One Health, promoting sustainable Health for prosperous communities, productive animals, and balanced ecosystems.** Adopting a university network was inspired by the evolving role of universities and higher education institutions (HEIs) in development affairs. As highlighted in the subsequent chapters, Africa's education sector has greatly transformed through liberalisation, internationalisation, and the quest for problem solving, competency-based education (21,23). These realities played out significantly when designing the OHCEA network and later AFROHUN.

At the time of OHCEA's creation, the East African region already had established networks to benchmark from or partner with where applicable. These include the Regional Universities Forum for Capacity Building in Agriculture (RUFORUM) - an agricultural initiative started in several African Universities in 2004 (24). AFROHUN envisaged building on such existing models to create a framework of cooperation and collaboration that would strengthen regional capacity not only in one discipline but across disciplines and sectors to improve the whole health system in the region. One needs to know (23) that many networks of health professionals have been formed but have not lasted long. So, it was critical to choose a suitable ingredient for success.

Collaboration among regional universities was attractive because universities offered opportunities and possibilities for long-term sustainable outcomes. They are stable settings for pre-service and in-service training and overall capacity development for outbreak management. (Sub-award document June 2012). Universities were also deemed a significant source of innovation for social and institutional changes. These institutions can foster transformative change, partly through their ability to impart new knowledge and nurture, catalyse and transfer new ideas from one context or generation to another. Universities are ideal regional cooperation partners, usually accommodating freedom of expression, and can shape national agendas directly and indirectly through training, research, and community service.

Expanding AFROHUN membership to new countries and institutions

At its conception in 2010, OHCEA was a consortium of institutions in six countries: Uganda, Kenya, Tanzania, Rwanda, the Democratic Republic of Congo, and Ethiopia (9). See Table 2.1 below: Because of the nature of pandemics and epidemics in animals and humans, it was necessary to bring on board some institutions in West Africa.

Such initial universities were from Senegal, and Cote D'Ivoire that joined in 2014. More institutions from other West African countries were encouraged to join, and at the time of writing this chapter, we were seeing interest from Somaliland, Benin, Mali, Nigeria and several other countries. The name then ceased to reflect what it stood for, and the leadership deemed it right to broaden the identity in order to accommodate the different countries. The name AFROHUN (Africa One Health University Network) was found appropriate to reflect the individual network inclusion and broader scope and mandate of the network.

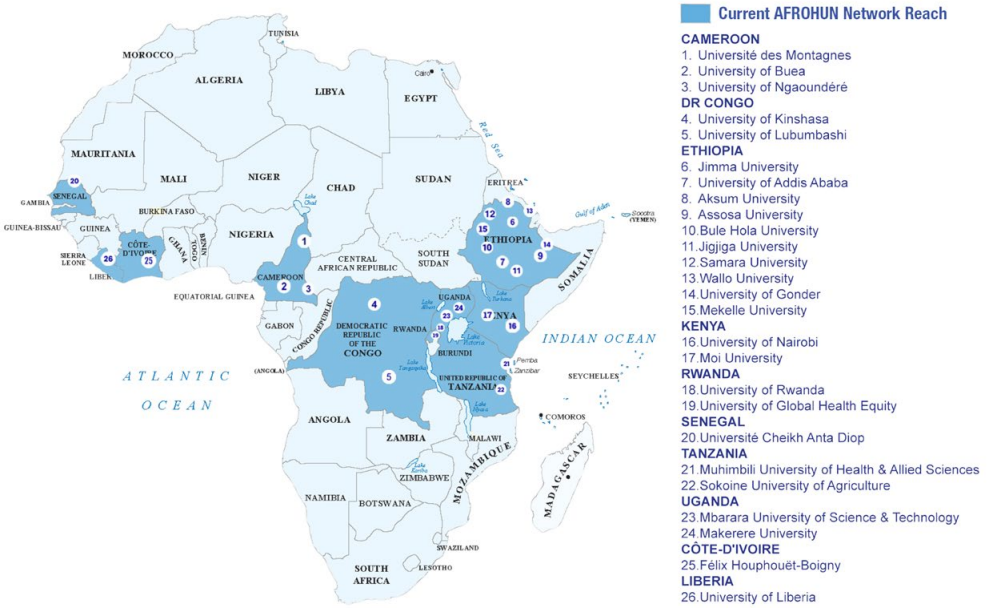

Figure 2.2: Map showing the AFROHUN member Institutions across Africa by 2024. Source: AFROHUN Secretariat.

Table 2.1: AFROHUN member universities and schools.

Member Institution	University	Country	Year of Joining
1) Faculty of Health Sciences University of Montagness (Composed of both Public Health and Veterinary)	University of Montagnes	Cameroon	2015
2) Faculty of Health Sciences	University of Buea	Cameroon	2016
3) Faculty of Agriculture and Veterinary Medicine	University of Buea	Cameroon	2016
4) School of Veterinary Medicine and Sciences	University of Ngaoundere	Cameroon	2020
5) Faculty of Medical Sciences	Felix Houphouet Boigny University	Cote D'Ivoire	2020
6) School of Veterinary Medicine	University of Lubumbashi	Democratic Republic of Congo	2009
7) School of Public Health	University of Kinshasa	Democratic Republic of Congo	2009
8) School of Veterinary Medicine	Mekelle University	Ethiopia	2009
9) School of Public Health	Mekelle University	Ethiopia	2009
10) School of Veterinary Medicine	Jimma University	Ethiopia	2009
11) College of Public Health and Medical Science	Jimma University	Ethiopia	2009
12) Akiliu Lemma Institute of Pathobiology	Addis Ababa University	Ethiopia	2016
13) Faculty of Veterinary Medicine	University of Nairobi	Kenya	2009
14) School of Public Health	Moi University	Kenya	2009
15) School of Public Health	University of Nairobi	Kenya	2009
16) University of Liberia		Liberia	2021
17) College of Agriculture, Animal Sciences and Veterinary Medicine (CAAVM)	University of Rwanda	Rwanda	2009
18) University of Global Health Equity	University of Global Health Equity	Rwanda	2017
19) Institute for Health and Development	The University of Cheikh Anta Diop	Senegal	2017
20) The Inter-State School of Veterinary Sciences and Medicine (EISVM)	The University of Cheikh Anta Diop	Senegal	2016

21) Institute of Environment (ISE)	The University of Cheikh Anta Diop	Senegal	2017
22) Faculty of Veterinary Medicine	Sokoine University of Agriculture	Tanzania	2009
23) School of Public Health and Social Sciences	Muhimbili University of Health and Allied Sciences	Tanzania	2009
24) School of Public Health	Makerere University	Uganda	2009
25) College of Veterinary Medicine and Biosecurity (COVAB)	Makerere University	Uganda	2009
26) Faculty of Medicine	Mbarara University of Science and Technology	Uganda	2017

Interprofessional and inter-university collaborations

When working with university stakeholders, AFROHUN's approach involved inviting university faculties in One Health disciplines to join the network and participate as full members. This approach reaped fruit to the extent that, at present, 19 universities and 27 schools in the universities are members of AFROHUN (6). Once they became members, the universities and their schools would be incorporated into leadership and activity structures, leading to the internalisation of the One Health concept. Prof Kabasa noted: *"Universities cross boundaries easier and faster than governments. This made universities very attractive as the best entry point for the One Health ideology."* Working across governments can be challenging due to bureaucratic systems, international relations concerns and foreign policy considerations. This is not the case regarding collaboration among universities. A vice chancellor of one university in one country can reach out to their counterpart in another country without much concern for diplomatic constraints. This meant universities became an attractive and strong foundation for spreading AFROHUN's advocacy in Africa. This choice came with the added benefit that universities are considered centres of knowledge and innovation. Any cause they champion is easily acknowledged and adopted by other stakeholders.

Enhancing multilevel, multidisciplinary and multisectoral collaboration through various efforts, OHCEA/AFROHUN has facilitated the development of collaborative structures, systems and processes to advance the One Health agenda within partner universities, countries, the African continent and beyond (25). Following the GHSA Workforce Development Action Package, the network through the One Health Workforce project recognised the value and need to strengthen national and international networks to share resources and best practices to enhance each country's ability to fulfill relevant IHR and PVS core competencies. These considerations have informed AFROHUN's efforts towards intentional growth and partnership development.

- **Faculty exchanges:** Faculty exchanges were conducted within Africa and with US universities involving 30 faculties from AFROHUN institutions.

- **Leveraging IT systems for collaboration and knowledge base:** AFROHUN installed the Tufts University Sciences Knowledgebase (TUSK) system in 10 institutions in Tanzania, Uganda, Kenya, and DRC universities. It was a follow-up on an award won in 2008 in response to a proposal submitted by Prof. William Bazeyo, the Principal Investigator at the HEALTH Alliance then. To promote sustainable use of the TUSK e-learning system, ICT managers from five member countries were trained in various system management and support areas, and 167 faculty members were from OHCEA institutions.
- **Network growth:** The network membership grew from 14 to 28 schools or faculties across 16 universities and eight countries.
- **Database:** During this phase, AFROHUN developed a database of health education experts from the region to support South-to-South technical coordination and regional faculty exchanges.
- **Networking with other One Health organisations:** The OHCEA/AFROHUN Regional Secretariat leadership shared their experience and expertise with other One Health educators in the region and around the world through various regional and international forums, including the OHCEA/AFROHUN International One Health Conferences, the SEAOHUN International One Health Conferences, the World One Health Congresses, the Conference on One Medicine One Science in the USA, and the Prince Mahidol Awards Conference in Asia. This is in addition to many other national, regional and international meetings where OHCEA/AFROHUN has been invited to speak.
- **AFROHUN has created more than 40 interdisciplinary Student One Health Innovation Clubs across Africa:** The creation and support of Student One Health Innovations Clubs (known as SOHICs) within member universities was an essential strategy for developing a highly skilled and collaborative future One Health workforce while promoting One Health awareness through club organised community outreach activities. These clubs provide valuable opportunities for students to work in interdisciplinary teams and sharpen their leadership and community engagement skills while learning about One Health.

Evolving governance and management structures in AFROHUN

AFROHUN has a well-structured governance and management structure (6), as Figure 2 below shows. In terms of governance, the Deans agreed that the top leadership organ of AFROHUN was the Leadership Summit, which comprises all the deans, directors, and principals heading the member institutions depending on the nomenclature used by the Institution. This summit operates as the oversight body and holds meetings at least twice a year. The Leadership Summit appoints the Board of Directors from different member universities or institutions, and all Board Members must be a current or former dean/director or principal. The Board oversees the network activities by supervising the Secretariat, headed by the Chief Executive Officer (CEO). The Board meets quarterly. The board has several subcommittees.

The last pillar in the governance structure of AFROHUN is the Secretariat, which is currently based in Kampala, Uganda. The Secretariat comprises professional and specialist managers who are competitively recruited to carry out the various programmemes mandated by the Board. The Chief Executive Officer of AFROHUN and the Programmemes Manager are members of the Board and seamlessly link the Secretariat and the Board.

On the programmematic front, the Secretariat, led by the Chief Executive Officer, oversees specialists leading specific functional departments such as programmeme administration, grant management, monitoring and evaluation, communication and knowledge management, training and research, and financial management and accountabilities programmeme.

Fostering One Health growth in Africa through outreaches: building a shared understanding of One Health approach through conferences and strategic meetings

As AFROHUN continued to grow and expand its influence in Africa, it has organised several conferences (see figure 4 below). The first One Health Conference was in Addis Ababa, Ethiopia, in 2013. This conference was attended by over 270 delegates from Africa and other parts of the world. One of the key messages from that conference was the importance of On Health practice as a policy prerogative and as a curriculum component in training One Health professionals.

Themed *'One Health and the Control of Infectious Diseases: Building Capacity, Systems, and Engaging Communities,'* the conference featured more than 110 oral presentations covering a broad spectrum of One Health-related topics. The keynote speaker was Dr. Dennis Carroll, the USAID Director for the Pandemic Influenza and Other Emerging Threats unit.

The second One Health Conference was held in 2015 in Kampala, Uganda, attracting more participants worldwide. The conference reinforced the message of One Health advocating

for making One Health a mainstream practice, from university teaching to government policy and practice in the field. The network hosted another international gathering—the 2019 One Health Conference in Uganda. Additionally, AFROHUN organised One Health launch events in Tanzania, the Democratic Republic of Congo, and Ethiopia. More than 580 participants attended these events, including policymakers, academicians, researchers, media professionals, and the public, as Figure 2.5 shows. The 4th One Health Conference was held in 2024 in Kenya and was attended by 295 participants.

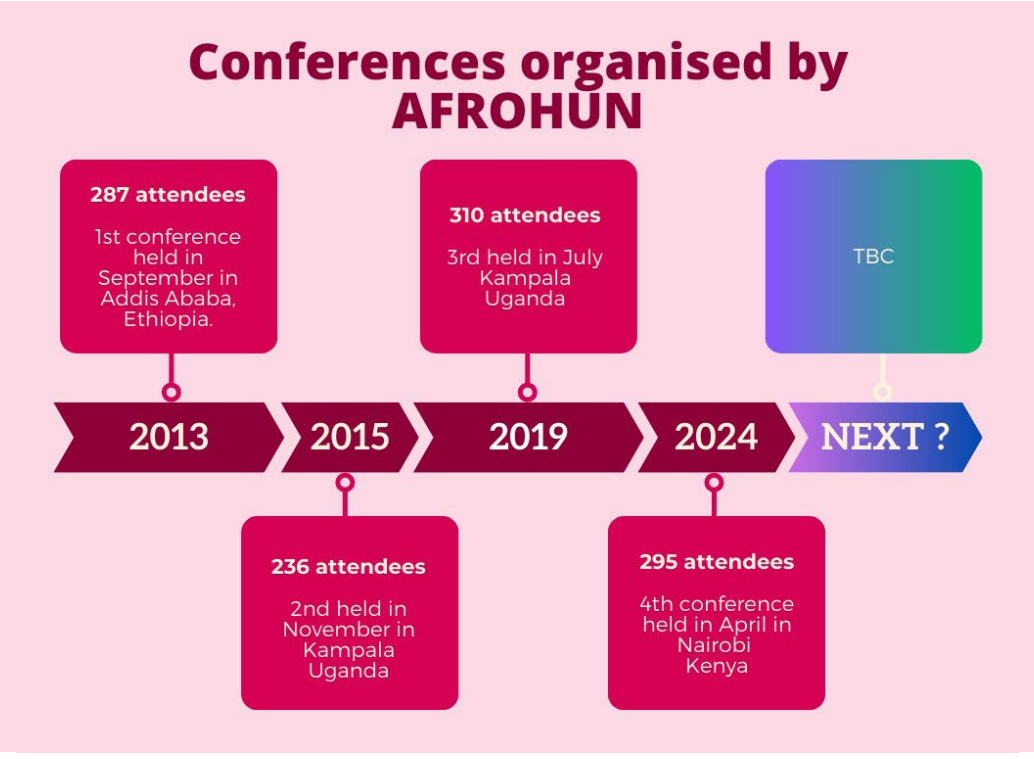

Figure 2.3: Overview of One Health Conference and number of participants over time

Engaging public sector: working with and through government systems

AFROHUN's methods of advocacy varied depending on the stakeholders involved. Prof David Kabasa, one of AFROHUN's founders and its Deputy Chief Executive Officer, noted: *"You cannot drive an inter-country or cross-continent agenda without the involvement and help of governments."* He pointed out how AFROHUN identified champions in various government departments with a link to OH. AFROHUN would involve these government champions in its multiple activities so that they could internalise the One approach. Further, whenever these champions needed support for outreach and awareness creation efforts, AFROHUN would provide financial and material support. This approach with governments was replicated across all AFROHUN-affiliated countries.

In the early 2010s, OHCEA influenced all member countries to establish, for the first time in the history of One Health, a management team for One Health at the national level comprising the deans of respective schools/faculties and country managers who were nominated from the multidisciplinary ministries (directly related to one Health) (9). Each County Management Team constituted a Country Coordinating Committee (CCC) and selected a chairperson from its membership. The country's priorities determined the agenda of the CCCs. The CCCs comprised faculty staff from partner universities in a member country, country offices and other key stakeholders such as government officials. The country office staff were accountable to the OHCEA/AFROHUN secretariat. These committees enabled a wide variety of views and interests during decision-making. They served pretty well in the early days of formation, and this eliminated making decisions and working in silos. With time, it became clear that CCCs required sizeable financial and logistical support that was not sustainable. The work of CCCs was then transferred entirely to the country staff, who liaised with faculty staff of partner universities and thematic and activity leads.

The AFROHUN CEO (Prof. William Bazeyo), the Director AFROHUN One Health Academy (Prof. John David Kabasa), the then Chair of the AFROHUN Leadership Summit (Prof. Frank Mwine-behind Prof. Bazeyo) interact with the then Prime Minister of the Republic of Uganda, Dr. Ruhakana Rugunda, at One Health Day celebrations in Uganda. The event was marked at Makerere University. Source: AFROHUN Secretariat.

The Dean, Faculty of Agriculture and Veterinary Medicine, University of Buea, Professor MVONDO Awono Jean Pierre, the Country Manager, AFROHUN Cameroon, interacts with Dr. Saly Ballo of the National One Health Platform at a One Health event in Yaoundé, Cameroon. Engaging government agents is a key approach to creating awareness and influencing policy and practice on One Health issues. Source: AFROHUN Cameroon archives.

There has also been much success with governments adopting One Health policies in their public health agendas in host countries and all over Africa (3,26). For example, in Uganda in March 2016, a ONE HEALTH Framework was developed, agreed upon and endorsed by the technical heads of three line ministries and the Uganda Wildlife Authority. The ministries were Health, Agriculture, Animal Industries and Fisheries, and Water and Environment. The Uganda Wildlife Authority is an agency in the Ministry of Tourism, Wildlife and Antiquities. In November 2016, the One Health Framework was formalised by signing MOUs between the involved ministries, which led to the establishment of the Uganda National One Health Platform (NOHP) (27). The NOHP involves multisectoral communication, coordination, and collaboration between the four line ministries concerned with the One Health disciplines. The NOHP then spearheaded the development of the Uganda One Health Strategic Plan, which has been the guiding document for the government in implementing the One Health policy in public Health.

Similarly, other East African countries have also developed One Health Strategic plans and One Health policies. In Kenya, the Zoonotic Disease Unit was established in 2011, and the One Health Strategic Plan for the Prevention and Control of Zoonotic Diseases in Kenya was later created (28). This plan was developed by the Ministry of Health working with the

Ministry of Agriculture, Livestock, Fisheries and Cooperatives. Tanzania developed its first One Health Strategic Plan in 2015, and the Prime Minister's Office coordinated the effort, ensuring that coordination was maintained between the highest levels of government.

Box 4: The Bonobo Human Resource Management System

AFROHUN DRC developed and handed over to government the Bonobo, an online One Health Human Resources management platform. A non-profit council of professional health corporations, "Federation Une Santé" (FUS), or One Health Federation in English, was established in 2010 to enable collaboration between health sector stakeholders in DRC. The FUS arose after stakeholders gathered for an EPT1 RESPOND project workshop to commemorate World Rabies Day in September 2010 (15). With support from the EPT2 One Health Workforce project, FUS launched the online human resources platform, "Bonobo" (named after the primate species unique to DRC). Bonobo's objective was to facilitate the exchange of knowledge and information among DRC physicians, pharmacists, nurses, veterinarians, and para-- veterinarians. Eventually, it will include a national registry of health professionals and information about academic and vocational health training programmemes in DRC. Bonobo aims to drive discussions and policies related to human resources in the health sector and facilitate the sharing of early outbreak alerts. Bonobo was officially launched by the Minister of Health in March 2019, marking a phase of close collaboration between FUS and the government to address health human resource management issues.

Box 5: Cameroon National Code of Conduct on Biosecurity and Biosafety

Cameroon developed a National Code of Conduct on Biosecurity and Biosafety (25). AFROHUN-Cameroon supported the development and validation of the National Code of Conduct on Biosecurity and Biosafety for Laboratories and Biological Resource Centres, which is expected to be adopted by the Cameroonian government. This Code of Conduct is based on best practice principles for scientists, health professionals, and institutions that work with biological resources, particularly micro-organisms. It aims to raise awareness of regulatory needs and to protect researchers, research facilities, and stakeholders. Adopting such a document calls for the implementation and compliance of awareness, accountability, and oversight, targeting all those engaged in life sciences and One Health work (laboratory workers, managers, stakeholders, and others).

One Health training workshops in Uganda were held in collaboration with AFROHUN, University of Minnesota (UMN), and the Uganda Ministry of Health (MoH). This effort resulted in the training of 50 participants, including 13 Health Officers and 12 Veterinarian Officers from 19 Uganda districts reporting epidemics and natural disasters. Community engagements through outreach Activities: AFROHUN supported more than 86 One Health community outreach activities in different project areas across the network. Regional bodies such as the African Union, East Africa Community, SADC, and ECOWAS have all incorporated One Health into their strategies.

Engaging with donors and non-state actors

When dealing with stakeholders such as NGOs and donor agencies, AFROHUN focuses on creating collaborative partnerships that enhance the network's work experiences. Such stakeholders are always invited to AFROHUN conferences and other events. Further, AFROHUN has always sought opportunities to work with key stakeholders in its various initiatives and projects. This strategy has facilitated the development of a shared understanding of the One Health approach with a multiplier effect as more and more stakeholders got involved directly or indirectly through their various programmemes and projects. AFROHUN organised a donor forum (crowdsourcing) meeting in Nairobi to introduce AFROHUN to the private sector, partners, potential funders, and NGOs and created a database for possible collaborators. This database has been a very useful resource as we always consult it when responding to grant calls and when we are organising conferences.

So, as AFROHUN continues to grow, its dream of having everybody possible on board is backed by data. AFROHUN embarked on an advocacy campaign, which has yielded results. The results of this blend of strategic and operational foci have attracted several universities in Africa to become members of AFROHUN, and most universities in AFROHUN countries now have a One Health component in their curriculum for human medicine and veterinary medicine degree programmemes. Further, master's level courses founded on the One Health approach have been adopted at several universities in host countries.

Delegates from funding agencies, AFROHUN member institutions, development partners, and government, posing for a group photo, after lengthy deliberations on the future of One Health funding and AFROHUN's position in furthering One Health workforce development in the region. This was at a special funders conference held in Nairobi in May 2014. Source: AFROHUN Secretariat archives.

Factors that have facilitated AFROHUN's evolution and contribution to One Health growth in Africa

Progressive funding of AFROHUN and the presence of active One Health champions in Africa and beyond

An initial small grant awarded to AFROHUN facilitated the establishment of the AFROHUN secretariat, country offices and country coordinating committees. Initially, AFROHUN had only two staff members: a Programmeme Manager, Dr. Geoffrey Kabagambe, and an administrator, Ms. Sarah Nitumusiima. Its office was a small room at Makerere University School of Public Health. Understandably, the challenge then was establishing structures at the Secretariat and at the six country offices manned by dedicated Focal Persons and Administrators, with support from that fixed Obligation Grant from the RESPOND project. The RESPOND Project was part of USAID's Emerging Pandemic Threats Programmeme (EPT 1) (15). The prime recipient was DAI (an international development company), from the USA.

The network got a second sub-award, *'Strengthening and expansion of One Health Central and Eastern Africa Network'*, which initiated establishing and strengthening the network. The total award amount was up to US Dollars 11.843,393 for the period of June 2012 to June 2016. The award facilitated AFROHUN to serve as a platform, fostering the establishment of a sustainable public health human resource base in the Democratic Republic of Congo, Ethiopia, Kenya, Rwanda, Tanzania, and Uganda. The long-term objective was to enhance responses to rare or episodic zoonotic events, recognising the critical role of a well-trained and adequately resourced workforce. This broader human resource base was envisioned to fortify the capacity to detect and respond to potential pandemic disease outbreaks and integrate surveillance and outbreak response across animal, wildlife, and human health domains. This broad mandate and potential benefits justified the investment in OHCEA/AFROHUN.

The second phase of funding was under the Emerging Pandemic Threats Programmeme (EPT 2) for the One Health Workforce (OHW) project that run from 2014-2019 (29,30). EPT2 was focused on mitigating the impact of novel "high consequence pathogens" that originate in animals with a goal of enabling early detection of new disease threats, effectively controlling those threats, enhancing national level preparedness in advance of outbreaks, and ultimately reducing the risk of these diseases emerging by minimizing human behaviours and practices that trigger the "spill over and spread" of new pathogens. The USAID One Health Workforce (OHW) project led by the University of Minnesota in partnership with Tufts University supported AFROHUN to create a global One Health workforce prepared to prevent, detect, and respond to the threat of infectious diseases and other complex health challenges around the world. The OHW project focused on 3 key strategies: multi-sectoral engagement, education

and training, and institutional strengthening. In 2014, the Global Health Security Agenda (GHSA) was launched in February, in response to the global threat caused by the increased prevalence of infectious diseases in the increasingly interconnected world (31). After the launch of GHSA, there was a pivot within the One Health Workforce project to align with the objectives set out by the GHSA.

In 2019, AFROHUN received a grant from the IDRC/CRDI (International Development Research Centre-Canada) Action Research to support women's agency and empowerment in Livestock vaccine value-chain (distribution, delivery and use). The project was a collaboration led by the Cummings School of Veterinary Medicine at Tufts University (TUCSVM). It assessed the state of empowerment and gender parity in the Vaccine Value Chain (VVC), identify key entry points along the value chain in which empowerment needs to be strengthened and provide a framework for synthesizing knowledge about gender roles and livestock VVC in three AFROHUN countries of Rwanda, Kenya and Uganda. The identified gaps and opportunities were used to empower women small holder farmers and entrepreneurs to contribute to and benefit from livestock vaccines thereby improving livestock production and their livelihoods. The information gathered can be scaled up and applied to other livestock vaccines and other countries in the region.

In 2020, AFROHUN received a 5-year USAID sub-award funded through a consortium led by the University of California Davis to implement the One Health Workforce – Next Generation (OHW-NG) Project (32). Under this initiative, AFROHUN continued to provide multisectoral education and training to build and strengthen One Health core competencies among the future and current workforces. Additionally, there would be an expanded scope to 1) target sub- national (e.g., regional, provincial, district-level) agriculture, forestry, wildlife, and public health officials, veterinary and public health paraprofessionals, as well as allied health professionals, 2) engage with technical and vocational training institutions as well as schools and faculties outside the ***"traditional"*** One Health disciplines, and 3) provide continuing education and teaching for adult learners.

As part of the One Health Workforce – Next Generation programmeme, from 2022, AFROHUN implemented a 2-year Transition Award as USAID Prime (25). The goal of the AFROHUN Transition Award was to develop and strengthen a local One Health (OH) workforce with the capacity to prepare, prevent, detect, and respond to infectious disease outbreaks and complex health challenges in the African region. The AFROHUN Transition Award strategy was to be implemented through the AFROHUN One Health Workforce Academy (OHWA) under the leadership and coordination of the AFROHUN Regional Secretariat (25). AFROHUN's focus under the Transition Award was to implement an experiential and synchronised training, research, and knowledge management strategy. This strategy was to be implemented through 1) designing and delivering regionally relevant training on risk communication and community engagement for rabies and COVID-19; 2) supporting professional development and research opportunities in zoonotic disease among students and faculty; 3) managing regional knowledge in curriculum development; and 4) tracking and engaging alumni to better understand and address One Health workforce gaps.

In 2021, AFROHUN received a 5-year USAID sub-award funded through Tufts University to implement the Strategies to Prevent (STOP) Spillover. The USAID STOP Spillover programmeme provides a critical opportunity to enhance global understanding of the complex drivers of viral spill-over and to augment sustainable national capacities in surveillance, risk analysis, and behaviour change. Implementation of the project envisions priority ten countries across Africa and Asia to gain critical knowledge about their spillover ecosystems, to refine and use that knowledge effectively, efficiently, and sustainably to reduce the risk of zoonotic viral spillover and spread.

The objective of the STOP Spillover project is to anticipate and address threats posed by emerging zoonotic diseases that pose the greatest risk of jumping from animals to humans. Tufts University, together with an international consortium of nine core partners including Africa One Health University Network (AFROHUN) and six core sub-award partners are working collaboratively utilizing diverse capabilities among consortium members and stakeholders to implement the STOPS project in five countries in Africa over five years.

The consortium supports countries in building their capacity to assess, communicate and decrease risk of viral spillover and spread of zoonotic diseases. The consortium works with USAID to develop and institutionalise innovative, country-specific, and sustainable approaches so they are well-prepared to stop viral spillover from animals to humans and reduce the amplification and spread of the virus among humans. STOP Spillover will focus on strengthening national capacity in several targeted countries to 1) understand the factors that contribute to the risk of spillover of pathogens from wildlife to humans; 2) develop, assess, and implement early risk-reduction interventions that will reduce the spillover and spread of these threats; and, 3) recognise and respond rapidly to zoonotic spillover events.

The STOP Spillover project is being implemented in Côte D'Ivoire and Liberia. The higher education institutions in these countries are working in collaboration to develop a health workforce at pre- and in-service so this makes them capable of addressing the increasingly complex health challenges such as zoonotic spill over and amplification, which is the focus of the STOP Spillover project.

In March of 2023, AFROHUN received a grant from GIZ to support a Knowledge Management Expert being seconded to AFROHUN to support the AFROHUN secretariat on specific knowledge management processes and expected results such as the production of a publication (s): "Growing One Health in Africa: AFROHUN's decade of experience". The products from this support will contribute to AFROHUN's knowledge resources useful for realising value-based training products and services to be offered under the AFROHUN Academy and for sharing with other actors.

Leveraging partnerships and opportunities for progressive mutual learning

The growth of AFROHUN and the advancement of One Health in Africa can be related to the various conferences and meetings organised by the network, as highlighted in section 2.7.1 above. Following the conferences, participants from various countries collectively make several resolutions, including requests for admission into the network. Other resolutions have included the development of national One Health strategic roadmaps, policy formulation for One Health, and integration of One Health into pre-service training. The discussions have also highlighted the need for a global reconsideration of health systems to facilitate the sharing of data and knowledge across sectors. These meetings have enhanced the visibility of the network and further emphasised the importance of One Health principles and approaches in diverse regions. These outreaches have provided opportunities for progressive learning within the network regarding the emerging One Health practice and theory developments. They have provided opportunities for networking with like-minded partners and individuals, supporting partnership growth and generating funding opportunities. These meetings have also raised the profile of AFROHUN as the convener.

Additionally, working with well-connected and networked partners like the OHW-NG consortium led by UC Davis with a well-established, mature One Health Institute, AFROHUN has been able to learn a lot and grow further as a regional One Health university network, with global reach.

How epidemics promoted the value of One Health approach

It is said the taste of the pudding is in the eating. This principle came true for Africa and other countries during the COVID-19 pandemic between 2020 and 2023(33). By March 2020, the pandemic was spreading throughout the world and Africa. The One Health strategies expressed in fancy; often voluminous government documents were tested to the limit. Across governments and states, multisectoral, whole of government and whole-of-society approaches encompassing One Health principles were adopted. These enhanced the adoption and implementation of pharmaceutical and non-pharmaceutical interventions and vaccination programmemes when vaccines became available. Through these multipronged efforts, it is argued that Africa fared the best among all the continents, with fewer than 300,000 deaths continent-wide. While Africa's tropical climate may have made it harder for the COVID-19 virus to last long in the environment, the contribution of prior planning cannot be wished away. Prior actions supporting One Health that had been put in place with the support of AFROHUN were essential. These included the development of One Health plans and strengthening structures such as One Health Platforms and District Taskforces.

Arguably, the COVID-19 pandemic provided an opportunity for those plans to be put into effect. However, judgment is required to recognise other players in this broad, dynamic, complex environment. AFROHUN alone cannot take credit for all One Health policy successes because other players were championing the same message (3). These include

the World Health Organisation (WHO), the Centres for Disease Control and Prevention (CDC), the OIE, among other key, national, regional and global bodies.

Nonetheless, AFROHUN's pivotal role in catalysing the One Health revolution in Africa[1] cannot be overlooked. Concerted efforts in advocating for the OH approach and domesticating it to ensure that the One Health principles were adopted at the regional, national and local levels have been a mainstay of AFROHUN's work.

A comprehensive strategy for One Health workforce development aligned with international agenda, regional needs and country priorities to ensure fit-for-purpose context

As indicated earlier, the core focus of OHCEA was creating a competent workforce to address health threats through One Health as a multidisciplinary approach. Innovative efforts were enacted across partner countries and were informed by global policy dynamics, regional needs and country priorities (5,8). The Global Health Security Agenda (GHSA), launched in 2014, highlighted the need for international health workforce development. These aspirations aligned with AFROHUN's mission to build a transformed, transdisciplinary workforce capable of preventing, detecting, and responding to emerging infectious diseases. AFROHUN became a key player in advancing this agenda, emphasising the need for a workforce equipped with tools and capacities for swift detection, action, and collaboration across sectors to address disease threats, globally.

AFROHUN also aligned with the OH Workforce Development agenda spearheaded by USAID. The USAID OH Workforce (OHW) Project, launched in 2014, aimed to transform the workforce in preventing, detecting, and responding to infectious disease threats. The following were the project's objectives:

- OH Workforce Assessments, Planning, and Policy Communication
- Education and Training of OH Students (Future OHW/ pre-service)
- Education and Training of Government Professionals/Health Practitioners (Current OHW/ in-service)
- Faculty/Staff Development and Improved Academic Offerings
- Organisational Development of Sustainable OHUNs

The OHW project strengthened university training programmemes; their design and delivery. The project facilitated national health workforce assessments and action planning. It promoted collaboration between university institutions and African governments to conduct national health workforce assessments, identifying and addressing One Health workforce gaps and needs.

Workforce assessments and disease investigations: The network facilitated nine national One Health workforce assessments, and the project supported 26 multidisciplinary investigations of local disease outbreaks. These assessments informed the creation of

1 There could be other reasons why Africa was not devastated by COVID-19 these include the tropical enviroment, previous infections with malaria etc

national strategic plans and action plans to tackle priority zoonotic and infectious diseases.

The capacity development initiatives encompassed various components to enhance One Health capacities and foster interdisciplinary collaboration across health sectors. The OHW project successfully trained 13,424 health professionals and faculty members across Africa, with a gender ratio of 35% female to 65% male (34). The participants included students, in-service professionals, and faculty members from various health backgrounds, fostering a diverse and inclusive One Health workforce. These issues are covered in Pre-service training (Chapter 3), In-service training (Chapter 4, and One Health research (Chapter 5). Their success and achievements and what we are learning from that, have informed the establishment of the AFROHUN One Health Academy (Chapter 6).

Gender Responsive Training, Research and Innovation.

AFROHUN promotes an active and visible policy of mainstreaming a gender perspective, which includes disability and social inclusion dimensions, in all training programmemes and research. AFROHUN is employing a three-pronged gender, disability and social inclusion (GEDSI) integration strategy to guide effective gender mainstreaming and inclusivity as follows: (i) building capacity in gender and social analysis and integration, (ii) engendering the processes, methodologies and structures of programmemes including training and research; (iii) generating evidence-based GEDSI-responsive targeted initiatives for more impactful outcomes. AFROHUN has developed a gender policy, strategy, roadmap and tools that support the GEDSI mainstreaming work. Promising lessons on gender focused research are available from the SheVax Project *"Hearing their voices: action research to support women's agency and empowerment in livestock vaccine distribution, delivery and use in Kenya, Rwanda and Uganda"*.

A Community Development Officer (standing far back, left, in brown coat) and a Vaccinator (standing far back, right, in black sweater) facilitating a gender transformative training under the SheVax project in Machakos, Kenya. Source: AFROHUN Secretariat archives.

The challenges encountered as OHCEA/AFROHUN evolved

Bringing together different disciplines and institutions under different countries with different institutional governance and political jurisdiction was not easy. Looking back to where all this started, one gives credit to resilience and patience and, indeed, to the funders, partners and persons who supported and believed in the founders. Belief and trust were essential components of success. Below, we reflect on the main challenges and efforts to minimise them.

Simply stated, universities are unique entities, and it was a challenge to work with universities as the core members of the partnership. As much as situating itself in universities was a strength because of these institutions' unique roles in training the One Health Workforce, it presented AFROHUN with unique challenges. For example, navigating bureaucratic systems was not easy. Universities worldwide are known for their independence and pride in managing their learning agenda, research priorities, and academic programmemes. Also, each university has its growth curve from its foundation to the charter award and its maturation as an institution of higher learning. Creating a cohesive unit among entities with diverse characteristics and, at times, divergent strategic aspirations has been an ongoing challenge. More so, as universities strive to position themselves comparatively better than others, dysfunctional competition may follow instead of collaborative action. It has taken utmost diplomacy and negotiation skills to navigate these realities. However, the network has managed to expanded without the loss of any members along the way.

Second, navigating historical divides between disciplines was the next heavy (second) challenge. Bringing together human health and animal health practitioners is fraught with subtle superiority contests, power struggles and, at times, incoherent interests. Human health professionals may infer that they are at the top of the pyramid, seeing that they treat human beings at the animal kingdom's apex. In general, in Africa, practising human medicine enjoys higher prestige and many African children are taught to aspire to it. In contrast, veterinary medicine in Africa does not enjoy the same clout. It is considered more of a government service to support livestock, agriculture and food security. Educating/ training a human medicine professional therefore, is considered a sacrosanct undertaking, that should not be interfered with.

Such deeply seated viewpoints also shape the career choices of many young people on the continent. It is not common to find young learners aspiring to be veterinary doctors. So, a siloed experience between human doctors and animal doctors is created from an early age, extending into their training and practice. Then, OHCEA, which focused on building interprofessional collaborations to advance the One Health agenda against this background, came in. There was evidence of power struggles for superiority to extend to the practitioners and decision-makers that got sucked in. In one instance, government officials in one of the AFROHUN member countries contested leadership for the national AFROHUN Coordinating Committee. The situation was only resolved after the animal health professional gave in to the human health counterpart. The Secretariat and, at times,

USAID, the funder, were drawn into such struggles. Thanks to clear leadership, all these issues were resolved and overcome.

The third challenge was colonial legacies: languages, cultural differences and unique government systems and processes, in which language became a centre of a continental enterprise like OHCEA/AFROHUN. Africa has always been a continent of many languages which have evolved over millennia. To avoid this challenge, the AFROHUN leadership approved using French and English as the official network languages. Working through the existing government systems has provided opportunities for sustainable change in the countries. Diversities in government systems have provided opportunities for a comparative approach and mutual learning across various settings. At first, each country had leeway to set its priorities in alignment with its uniqueness.

Insights from the Secretariat affirmed that this created challenges for monitoring progress and creating a coherent package of efforts across the partnership. Progressively, the Secretariat has been more directional to country teams, offering guidance and continued support over the priority areas for the national governments, network and the funder. However, even where a common approach to engaging governments or priority actions has been agreed on at the network level, the practicalities within the countries have been contextually adapted to enhance successful implementation.

Chapter Summary

In summary, the Africa One Health University Network has been and continues to be a critical partner to Africa's provision of public Health under the One Health concept. The following chapters will delve into AFROHUN's detailed work in training the One Health workforce and in research. However, a summary in this chapter is useful to highlight the outcomes of these developments.

- **Policy advocacy:** It has been demonstrated that AFROHUN has been at the forefront of promoting One Health in Africa at a time when the concept was little known and practised. Today, African governments and regional bodies have developed One Health policies and strategies, and in many of these cases, AFROHUN has made significant contribution and investment. While AFROHUN did not achieve this level of awareness on its own, AFROHUN's role as a leader and catalysing organisation has been well-documented.
- **Education and Training:** AFROHUN has been involved in integrating One Health competencies into education programmemes across its member institutions. The integration has included curriculum development, interdisciplinary training, and capacity building. This has been in the organisation's pre-service training. In addition, AFROHUN has been actively conducting in-service training for professionals in One Health related sectors, building required competencies. This has resulted in creating a One Health Workforce that plays a great role in preventing epidemics and pandemics and is ready to respond to outbreaks and other complex health challenges, when they occur.

- **Research Initiatives:** This is a growing area for AFROHUN. The organisation has supported academics and students with grants to carry out various studies covered in Chapter 5 of this book.
- **Collaborations and Partnerships:** AFROHUN's achievements covered in this book were achieved through working with various partners and collaborating organisations. AFROHUN has worked with USAID, IDRC, and GIZ on the funding front. These organisations have supported various initiatives. The organisation has also collaborated with universities, colleges, national and sub-national governments, regional authorities, multilateral organisations, the quadripartite, and private sector organisations.
- **Outreach and Community Engagement:** AFROHUN continues to invest in an approach that empowers communities to engage with the One Health agenda. Examples of how this is done include; community outreaches by students in their SOHICs, engagement during and through One Health Demonstration Site Field Attachments, outbreak investigation and response, among others.

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PART II

AFROHUN IN ACTION

CHAPTER 3

Building a field-ready One Health workforce through innovative pre-service training approaches

Peninah Nsamba, Protus Musotsi, Miguiri Kalandi, Adolphe Atuhire Ndikubwimana, Gabriel Tumwine, Patrick Kalibbala, Simon Peter Alubbe, Milly Nattimba

Introduction

The global community faces an increasing emergency and re-emergency of health challenges, including zoonotic disease outbreaks, antimicrobial resistance, and environmental degradation. In addition, there is an increase in morbidity and mortality due to Non-Communicable Diseases, health system fragility and weak governance systems (1,2). In the health sector, the challenges are getting even more wicked and complex with emerging and re-emerging health-related threats, requiring the collaboration of several sectors to address them (3). These challenges require multidisciplinary approaches to address them. While siloed professional education has been, and is largely, still the norm in many higher education settings, the ever-evolving context and challenging work environment demand a change in how the professionals who are expected to manage these challenges are trained.

Pre-service training is a crucial stage in shaping future professionals with competencies to navigate the intricate landscape of interconnected health systems and development

challenges (4,5). The integration of One Health principles and competencies into pre-service training aims to bring together traditionally siloed disciplines, fostering collaboration and a shared understanding of the interconnectedness of health systems. Pre-service One Health training, especially at the undergraduate level, provides precious rooting in what individuals see themselves as future professionals. For example, the curriculum, the way it is delivered and the competency of the instructor are all key ingredients in building a competent, field-ready workforce (6).

The African One Health University Network (AFROHUN) emerged as a pioneering force in One Health workforce development in Africa (7). Being a university network, AFROHUN is well-positioned to support workforce transformation, especially in universities, through the integration of One Health competencies in pre-service degree programmemes and the establishment of short training programmemes and activities. The purpose of the chapter is to shed light on developments in AFROHUN pre-service workforce development, reflecting on how this was done, the outcomes, the mechanisms and the factors that facilitated or constrained the realisation of the outcomes. In the last chapter of the book, we will reflect on emerging issues in pre-service workforce development and what the future requires.

The guiding questions are:

1) What are the critical capacity needs for One Health in LMICs?
2) How did AFROHUN propose to address these?
3) How did these work in practice? What made them work or not?
4) How were capacities for One Heath strengthened at the individual, organisational and network level, and what were the contributing factors and constraints?

The chapter expounds on the One Health capacity needs for Africa and the need for pre-service training as a sustainability strategy (7,8). It briefly reflects on the trends in African education systems, emphasising the ongoing momentum towards competency-based education through curriculum development and review. It then highlights the key competencies for a multidisciplinary One Health workforce.

The next section discusses how AFROHUN purposed to contribute to the pre-service One Health workforce development. The pre-service workforce in the AFROHUN setting refers to individuals undergoing training before entering the professional workforce. This category encompasses various levels of training, both in undergraduate and postgraduate education. AFROHUN recognises the significance of cultivating a diverse and skilled cadre of professionals, including but not limited to physicians, veterinarians, ecologists, and public health experts, all of whom play pivotal roles in the One Health paradigm. The Theory of Change is then illustrated, showing the impact and causal pathways.

The next section discusses how AFROHUN purposed to contribute to pre-service One Health workforce development. The pre-service workforce in the AFROHUN setting refers to individuals undergoing training before entering the professional workforce. The Student One Health Innovation Clubs (SOHICs) are discussed in detail to underscore the motivation and rationale for their establishment, examine their implementation experiences

and outcomes and identify influencing factors. The chapter concludes with an evaluation of learning at various levels, highlighting the multifaceted contributions to One Health capacities at individual, institutional and system levels in Africa and beyond.

The context for pre-service One Health training

The narrative in workforce development has moved from knowledge or skills to competencies, reflecting the changing world, where the needs of society inform how training approaches are designed and implemented (9). Emerging trends and debates underscore the focus on competency-based education. Competency-based education (CBE) became a real issue in education when employers started demanding graduates that fit within specific and evolving industry needs and requirements. Competency-based education, therefore, has a strong emphasis on ensuring that the workforce stays 'relevant and adaptable'. In the corporate and business world, innovations for better products and company efforts to out-compete each other resulted in strategies to keep employees up to date in 'skills' (10).

The One Health approach is one of the models that is increasingly getting integrated into workforce development to deliver a workforce that understands and is ready to address health challenges through multidisciplinary collaboration (11). One Health training at the pre-service education level is a sustainable approach to building a field-ready workforce. Compared to training once one is already in the labour market, pre-service training ensures that one gets out of the training with the right mindset and capabilities. When students apply to join university, they have dreams of becoming engineers, doctors, nurses, laboratory technicians, veterinarians, environmental scientists, social scientists, teachers, and economists, among others, and some have clear images of what their work will be. While this is still the case, for one to become a more relevant professional, training approaches are changing, shifting from siloed models to multidisciplinary, inter-disciplinary and trans-disciplinary, competency-based models (9). The rationale behind incorporating One Health training into pre-service education lies in the need to address the complex health issues that require interdependencies between human, animal, and environmental health.

The country workforce assessments indicated an inadequate workforce to address the One Health challenges, like zoonotic diseases and outbreaks, climate change and food security, that are very common in the region (12–17). Even then, the limited workforce available lacked the necessary One Health competencies to undertake the required work. AFROHUN strengthened efforts to address interdisciplinary health challenges by designing and implementing multidisciplinary curricula, fostering cross-disciplinary collaboration, and creating a network of institutions committed to the development of the workforce required for complex health challenges, using the One Health approach (7,18).

AFROHUN strengthened efforts to address interdisciplinary health challenges by designing and implementing multidisciplinary curricula, fostering cross-disciplinary collaboration, and creating a network of institutions committed to the development of the workforce required for complex health challenges, using the One Health approach (7,18). AFROHUN's innovative approaches extend beyond curriculum development to the promotion of research collaboration, knowledge exchange, and practical experiences that transcend

traditional boundaries. By incorporating real-world challenges into education, AFROHUN aims to produce a workforce that not only understands the principles of One Health but is also proficient at applying them in diverse and dynamic settings. The training approaches adopted can mould an independent but interdependent professional at the same time. They are student-centred and wholesome. USAID has mainly funded these efforts. AFROHUN has been part of global consortia to develop a competent workforce that can detect, respond and prevent the next disease emergency, focusing on competency-based education.

Defining One Health's core competencies for a multidisciplinary workforce

To appreciate the work AFROHUN does, and the approaches used, it is important first to examine the One Health Core Competencies (OHCC). One Health Core Competencies aims to deliver the transformational education, necessary to prevent and respond to complex health challenges (6,19).

The process of developing OHCC in AFROHUN began as far back as 2010, when AFROHUN, working with partners in the USA, embarked on the task of developing an OHCC domain framework (20). With the original global set of competency domains being Planning and Management, Communication and Informatics, Culture and Beliefs, Leadership, Collaboration and Partnership, Value and Ethics, and Systems Thinking, AFROHUN worked from this base and added additional domains that gradually became 16. These were later expanded to 19 as shown in Box 1 below.

AFROHUN Competency Framework

Competencies by Domain (2021)

DOMAIN	DESCRIPTION
1. ONE HEALTH PRINCIPLES AND CONCEPTS	Explain the history and concept of One Health; Describe the OHCC domains and their application; Describe the application of the One Health approach.
2. INFECTIOUS DISEASE MANAGEMENT AND FUNDAMENTALS	Identify and analyze the risk factors associated with illness during an infectious disease outbreak or epidemic; Design and implement an IDM plan; Evaluate the effectiveness of One Health actions in infectious disease management; Design a disease surveillance and monitoring system.
3. OUTBREAK INVESTIGATION AND RESPONSE	Apply steps in conducting outbreak investigation; Review investigation and outbreak management experiences for applying best practices for potential outbreak events; Use systematic approach for outbreak response; Use systematic approach to recovery from outbreak and return to SOP.
4. ECOSYSTEM HEALTH	Understand fundamental ecological/ecosystem principles; Recognize interrelationships among ecosystems, animal health and human health; Analyze the effects of direct impacts on the environment
5. ONE HEALTH EPIDEMIOLOGY	Apply epidemiological thinking and a public health approach to a OH related health issue or disease; Implement and interpret surveillance systems to assess OH related health issue or disease; Provide OH policy recommendations based on epidemiological analysis
6. ONE HEALTH RISK ANALYSIS	Conduct One Health Risk Assessment and Analysis; Risk Management: Implement One Health Risk Management and Mitigation; Risk Reporting: Conduct One Health Risk Communication and Reporting


AFROHUN Competency Framework
Competencies by Domain (2021)
DOMAIN
DESCRIPTION
7. ONE HEALTH RESEARCH
Research programs: develops research programs; Ethical conduct: ensures the ethical and responsible conduct of research; Research foundation: integrates scientific and technical knowledge for use as a foundation for research; Research project execution: conducts research to address a public health issue or answer a public health question; Research data management, analysis, and application: conducts research according to professional standards of data management, analysis, and application; Dissemination of research findings: disseminates research findings; Translation: translates research findings to public health practice
8. ONE HEALTH LEADERSHIP
Articulate a shared mission, set of core values, and vision to achieve OH goals; Utilize collaborative methods and skills of negotiation and conflict management across sectors and disciplines to facilitate cooperation in working together to address challenges and achieve OH goals; Motivate, coach, mentor, and mobilize the OH team to work together to achieve OH goals; Apply ethical principles and professional code of conduct in leadership of OH programs.
9. DOMAIN: ONE HEALTH MANAGEMENT
Ensures sound management of OH organizational operations; Plan, Design, Implement, Monitor, and Evaluate OH Programs; Ensures sound OH financial management; Ensures effective management of human resources for OH; Ensure readiness to prepare and respond to emerging pandemic threats and outbreaks
10. SYSTEMS THINKING
Describe the elements of complex problems and systems thinking; Utilize wicked theory for systems thinking; Create and use systems mapping to deepen understanding of One Health problems; Develop a Causal Loop Diagram for systems thinking; Partner with One Health team members to develop solutions to complex One Health problems using systems thinking and tools; Develop interprofessional, interdisciplinary and multisectoral collaboration for systems thinking
11. ONE HEALTH COLLABORATION AND PARTNERSHIP
Promote inclusion of representatives of diverse constituencies across human, animal, environmental health and other relevant disciplines; Work with individuals of other professions to maintain a climate of mutual respect and shared values; Use the knowledge of one's own role and those of other professions to appropriately assess and address the needs of the organization and populations served; Communicate with all stakeholders in a responsive and responsible manner that supports a team approach to the strengthening OH systems and to promote OH.


AFROHUN Competency Framework
Competencies by Domain (2021)
DOMAIN
DESCRIPTION
12. ONE HEALTH COMMUNICATION AND INFORMATICS
Deploys formal written and oral communication strategies; Displays active listening skills when interacting with others; Demonstrates comprehension of written documents and directions; Utilizes technology to communicate information to internal and external partners; Ensures professionalism in communication with customers and stakeholders; Prepares professional written reports and oral presentations; Applies emergency and risk communication principles and techniques to explain information to targeted audiences; Promotes the value of the public health; Works with the media to provide information about public health laboratories and public health issues.
13. GENDER, ONE HEALTH, AND INFECTIOUS DISEASE MANAGEMENT
Demonstrate awareness of gender dynamics in emerging pandemic threats (EPT); Evaluate how gender intersects with emerging pandemic threats; Develop gender-sensitive response plans for emerging pandemic threats.
14. ONE HEALTH POLICY AND ADVOCACY
Demonstrate Awareness of the OH Political Process; Analyze OH Policy and identify the different challenges involved in development and implementation; Plan, design, develop and implement OH Policy; Organize national and international stakeholders in negotiating for OH policy; Utilize principles of social marketing and advocacy to communicate routinely with target audiences regarding OH needs, objectives, accomplishments, and critical information; Translate community and organizational analyses and plans into specific regulatory actions and legislative proposals for OH.
15. BEHAVIOR CHANGE (SPECIFIC TO ONE HEALTH)
Explain behavior change theories and change management concepts; Adapt and apply models for individual behavior change to One Health contexts; Adapt and apply models for community behavior change to One Health contexts

Source: OHW-NG Project One Health Competency Framework Toolkit, 2020

The process of developing the competencies was lengthy and consultative but rewarding, as this was a major milestone in the life of the network(21). Later in its life, AFROHUN developed modules aligning with these competencies.

AFROHUN Pre-service workforce development theory of change

The primary goal of AFROHUN Pre-service Training Theory of Change is to outline a comprehensive framework for pre-service training, ensuring the effective preparation of professionals equipped to address the complexities of interconnected health systems (7, 8). This theoretical model aims to foster a holistic understanding of the relationships between human, animal, and environmental health, promoting collaborative and adaptive approaches to managing public health challenges.

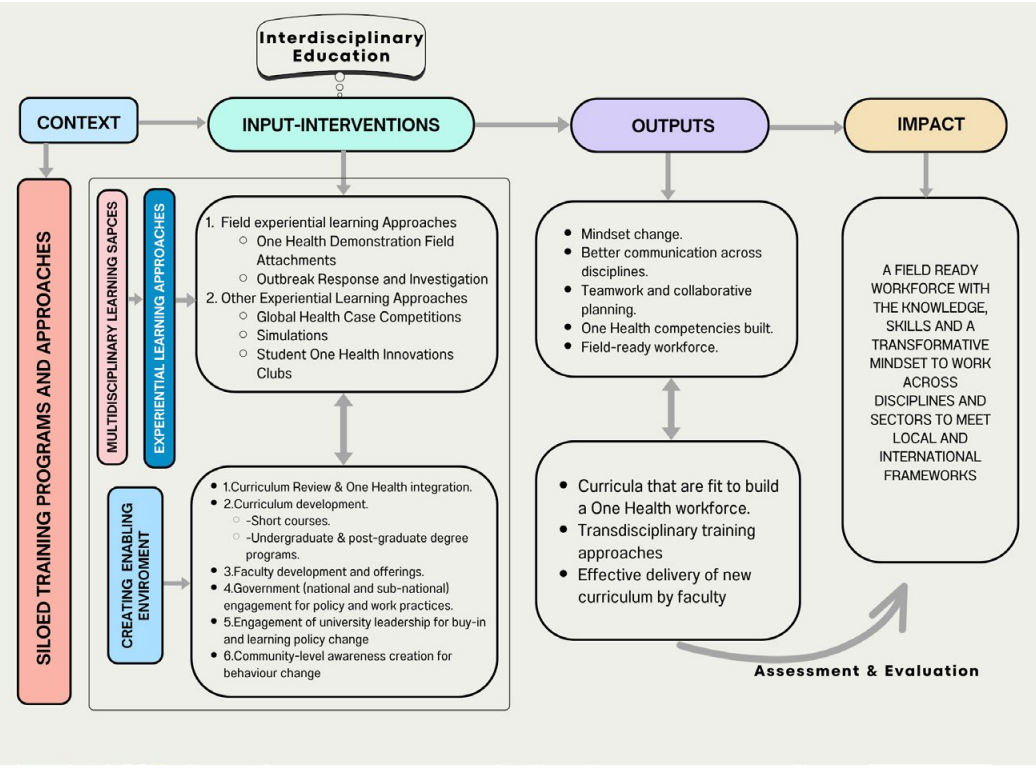


Figure 3.1: AFROHUN Pre-service Workforce Development Theory of Change.

Components of the theory of change

Context:

The One Health pre-service workforce development, as introduced in the introduction section above, was majorly motivated by the presence of siloed training programmemes and approaches to One Health workforce development. These realities stimulate two major domains of intervention: a) creating an enabling environment and b) multidisciplinary and multifaceted learning spaces.

Input -interventions

1) **Creating an enabling environment.** This entails strategic engagement of various stakeholders and development and roll out of curricula and training programmemes at the universities in most countries, and lower-level training institutions in Tanzania, particularly.

- **First,** engagement activities targeting key stakeholders, including educators, policymakers, and community leaders, were to be established. Core activities include mounting campaigns to raise awareness about the interconnected nature of health and the importance of a One Health approach and ensuring buy-in of the new training programmemes. This was expected to lead to increased recognition of the significance of One Health principles in pre-service training programmemes.
- **Second,** curriculum development and integration: This includes collaborating with curriculum developers, subject matter experts, and educational institutions to integrate One Health concepts into relevant courses, ensuring a cross-disciplinary approach in pre-service training. The direct outputs include updated curricula reflecting One Health competencies across various health-related disciplines. The definition of health-related disciplines was left to each institution to manage, depending on their circumstances.

2) **Experiential Learning:** Through the allocation of resources for practical experiences, AFROHUN member institutions would implement hands-on training activities and programmemes, such as One Health Demonstration Site Field Attachments, Global Health Case Competitions, Hackathons, Tabletop Simulations, Outbreak Response and Investigations, among others. Through Student One Health Innovations Clubs (SOHIC), a student-led programmee to engage students as One Health champions would be rolled out across the continent. The output expected were graduates with practical skills and a deep understanding of applying One Health concepts in real-life scenarios. Other competencies include teamwork, collaborative planning, One Health leadership and better communication across the partnership and stakeholder groups, including at the lowest level of the community.

Support actions

To achieve the envisaged objectives, the core action areas were to be supported by a) deliberate intersectoral collaboration and b) a comprehensive monitoring, evaluation and learning framework.

- **Interdisciplinary education** is critical to developing a competent, field-ready One Health workforce. AFROHUN would facilitate networking opportunities and partnerships between different health professionals, including faculty and in-service professionals who worked as instructors. Through organising workshops, conferences, and collaborative projects, AFROHUN was expected to bring together students from diverse disciplines. The development of a culture of interdisciplinary collaboration was expected during training and over time, fostering teamwork and mutual understanding and respect among future health professionals.
- **Assessment and Evaluation:** To track progress and monitor achievement,

the network is expected to develop assessment tools aligned with One Health competencies. These tools would enable regular monitoring and periodic evaluation of student performance using diverse assessment methods, ensuring the mastery of One Health principles and competencies. This monitoring would include tracking alumni to assess how competencies are being used in practice. Graduates are expected to demonstrate the ability to apply One Health concepts in problem-solving and decision-making.

Outcomes

Several outcomes are envisaged from the One Health pre-service workforce development efforts at individual, institutional and system levels.

i) Individual level outcomes

Well-prepared professionals with a deep, practical understanding of the interconnectedness of human, animal, and environmental health. The Kirkpatrick evaluation model (22) informs the assessment of training at four levels, including learners' reactions, learning outcomes, behavioural performance, and results (organisational outcomes) (23).

ii) Institutional and systems-level outcomes

Increased collaboration and communication among diverse health-related disciplines and improved public health outcomes through the application of holistic and adaptive approaches to managing complex health challenges. This is closely linked to the domain of creating an enabling environment above there.

In general, the TOC above serves as a guide for designing, implementing, and evaluating pre-service workforce development programmemes, ultimately contributing to a cadre of professionals ready to address the multifaceted challenges of the global health landscape. In the next sections, we unpack the different aspects of the One Health pre-service workforce development.

AFROHUN Approaches to pre-service workforce development

Creating an enabling environment: A strategic focus on institutional and system changes

In all countries where AFROHUN is, One Health was a new concept and outreach to create understanding was necessary for uptake. Some of the initial activities of the network were the engagement of government ministries, departments and agencies to lay the ground for institutionalisation and policy (24). As highlighted in chapter 2, one of the structures that AFROHUN supported to be created were Country Coordinating Committees (CCCs), which helped in enhancing One Health knowledge among government agencies. One of the key roles of these multisectoral bodies was ensuring that One Health actors were not engaging in a siloed manner. The outcomes of this engagement were varied, with some countries seeing results at the strategic level. For example, AFROHUN Tanzania

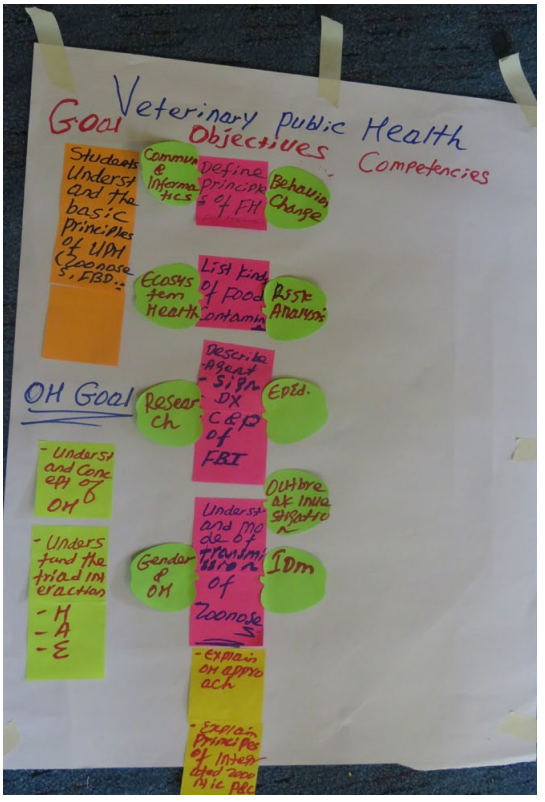
contributed to the development of the National One Health Strategy and the creation of One Health Desk in the Office of the Prime Minister. Most recently, this led to the creation and appointment of One Health Focal Persons in MDAs. In Uganda, outcomes of the engagement processes have included AFROHUN supporting government officials' attempts to draft a One Health policy.

At the institutional level, engagement of university leadership and management of schools, institutes and colleges (deans, directors and principals in some cases) were engaged especially in curricula review and development processes (20,25). It is important to note at this point that deans form AFROHUN's apex decision-making organ, the Leadership Summit. This arrangement was useful in generating buy-in, interest and ownership of the network, One Health capacity development processes and, very importantly, curriculum review and programmeme development efforts, as well as institutionalisation. Below, we reflect on the efforts to build supportive institutional contexts for pre-service One Health workforce development.

Curriculum Review, One Health Integration, Programmeme Development and Delivery

Faculty from the University of Nairobi – Kenya, (led by the then Focal Person for the University of Nairobi College of Agriculture and Veterinary Sciences, Professor Charles Mulei, engage in an intense discussion during a curriculum review workshop. Source: AFROHUN Kenya archives.

The need for new programmemes or curriculum review was quite obvious in the countries where AFROHUN started. One Health was not a big issue then, so there was a need to introduce it and integrate it into the academic programmemes (25). This is the case in countries like Uganda, Rwanda, Kenya, Tanzania and Ethiopia. As understanding and appreciation of the concept gained currency, more systematic needs assessments were conducted. In DRC, a scoping exercise revealed that there was no specialised programmeme on wildlife health and management. However, the country is very rich in flora and fauna and is a hotspot for infectious diseases. It was also realised that the country did not have the faculty required to teach such programmemes. In Kenya, before the MSc. Infectious Disease and Global Health was started, and an assessment was conducted to assess need, ability to pay for it and employment potential. These assessments informed how the different programmemes were shaped and implemented.



An image of the results of such discussions from Jimma University, Ethiopia. Source: AFROHUN Kenya archives.

Developing short courses on One Health

Against the background of little or no curricula, modules, teaching material or examples on One Health, it was decided to develop novel short courses using non-traditional methods. Learner-centred curricula were designed to facilitate the grouping of the anticipated course participants into multidisciplinary learning teams (26).

Subsequently, the course participants would have to take an active role in their learning by bringing onboard competencies and experiences from their degree courses or community experiences and integrating these with the important information being taught. The course developers visualised the end products of the short course or the competencies the participants would have gained after attending a particular module.

Because there were not many textbooks on One Health to refer to, the course developers (who were mainly teaching at the universities) had to meet as multidisciplinary subject matter experts and build up the teaching material to be used for orientation and sensitisation of both university students and lecturers. One of the first workshops was at Dar-es-Salaam in 2016, where regional experts from the initial six member countries of the OHCEA network

from the disciplines of Veterinary Medicine, Human Medicine, Nursing, Public Health, Environmental Health and Social Sciences met to develop teaching materials on Gender, One Health, and Infectious Disease (25–27). Case studies from field experiences obtained during Ebola, avian influenza, rabies, brucellosis, and anthrax outbreaks in communities, urban centres, and rural settings, including the wildlife interface in Africa, were highlighted.

B) University of Rwanda faculty work in small groups during a training on designing case studies on One Health and D) Faculty in the workshop post their thinking on flip charts using Stick-It notes. In photos A and C, University of Jimma faculty and Mekelle University faculty participate in curriculum review and One Health integration workshop. Source: A) AFROHUN Ethiopia, B) AFROHUN Rwanda, C) AFROHUN Ethiopia, D) AFROHUN Rwanda.

Standardisation of One Health materials

The network, through the Regional Secretariat, developed a suite of 16 One Health modules that country teams used in the curricula review and One Health integration processes. This provided useful and critical material for the country teams as reference resources, as many did not have to generate new content. It was also a good quality control measure, ensuring that countries were using the same content developed by the network instead of each team sourcing from different places. One of the most notable meetings too place in March 2016 in Tanzania featuring 15 faculties from the seven AFROHUN countries and 3 AFROHUN Secretariat Staff. This 5-day trainer of trainers (TOT) workshop focused on Gender, One Health and Infectious Diseases. Participants were drawn from different disciplines, including Veterinary Medicine, Human Medicine, Nursing, Public Health, Environmental Health and Social Sciences.

This standardisation process was triggered by lessons learned from the country-level initiatives of developing short courses, as described in the section above. The following core teaching modules were developed, with their associated case studies in 1) One Health Leadership, 2) Systems Thinking, 3) Risk Communication, 4) Epidemiology, 5) Policy and Advocacy, 6) Behaviour and Ethics and 7) Infectious Disease Management.

Despite the standardisation efforts, countries that had unique needs were allowed to develop modules/manuals to address their priorities. This was the case for DRC, where

building the capacity of territory administrators, in One Health leadership was a priority need (see Chapter 4). Generally, the centrally-developed materials served as a reference from which member countries could draw and customise to meet their specific needs.

Participants at the gender and infectious disease management Trainer of Trainers (TOT) workshop in Tanzania, March 2016.

Later, this system of developing One Health-specific modules trickled down to the local universities in the initial seven AFROHUN member countries who worked together in similar multidisciplinary teams under the leadership of the AFROHUN Regional Secretariat and US partners to build case studies and teaching modules for both student or in-service staff (lecturers, district staff) (21). This called for lecturers to adapt to change and work in collaborative teams outside the comfort of their disciplines in contrast to the more conservative lecturers who preferred to remain in mainstream traditional teaching (28–30). One of the key aspects of this process is that teaching materials developed were pre-tested on actual learners.

Facilitators meet to pre-test the modules to be presented to learners from the Institut Supérieur des Techniques Médicales and the Faculties of Medicine, Veterinary Medicine and Pharmacy and the School of Public Health, University of Kinshasa, in DRC. Source: AFROHUN DRC archives.

A faculty trained in OH Curriculum demonstrating the interconnectedness of the Pillars of the Health Systems using pieces of string to undergraduate students at Makerere University in 2018. Source: AFROHUN Uganda archives.

Although this method of implementing One Health teaching was innovative in delivering a multidisciplinary environment, it is difficult for universities to sustain independent modules that are not incorporated into the mainstream curricula. It is also difficult to create time on the university calendar to accommodate extra multidisciplinary modules and get students to pay additional tuition for the learning. However, some universities like Makerere University still have ongoing processes on institutionalisation of the short courses.

Table 3.1: Numbers of short courses or modules developed at the country or regional level

Name of Short Course Developed*	Numbers developed	Regional / Country
Behaviour Change	1	Regional
Management	1	Regional
Culture and Ethics	1	Regional
Ecosystems	1	Regional
Collaboration	1	Regional
Leadership in One Health	2	Regional / Uganda
Gender in Risk Management Gender	2	Regional / Uganda
Disease Surveillance	1	DRC
Communication Risk Communication Preparedness and Response and Communication	2	Regional /Cameroon/Kenya
Antimicrobial Resistance	2	Uganda/ DRC
Policy and Advocacy Health Policy Analysis	2	Regional / Uganda
Principles and Concepts of One Health	4	Regional /Cameroon/ DRC/ Senegal/ Uganda
Outbreak Investigation and Emergency Response Epidemiology Response to Epidemics Disease Response	5	Regional /DRC/ Uganda

***Learning and Adaptation:** After the initial engagement with the traditional One Health disciplines in the One Health Demonstration Site Field Attachments and other activities, and realising the many benefits of enhancing the learning experiences of the students, some countries are opening up to more disciplines, both as trainers and trainees.

Faculty development and offerings

Retooling of faculty

The retooling of faculty is imperative for the successful implementation of pre-service training in One Health, as it ensures that educators possess the necessary expertise to convey the interdisciplinary and interconnected nature of this approach effectively (7,31). One Health requires faculty members to transcend traditional disciplinary boundaries, integrating knowledge from various health domains. Faculty retooling involves updating educators' skills, knowledge, and pedagogical approaches to align with the dynamic and collaborative ethos of One Health. One key aspect of this work has been training staff in the integration of One Health programmeme design as well as instructional design, including online delivery of teaching. This was done to ensure that the teachers who have been teaching from their 'traditional perspectives' are now fit to teach using the One Health approach.

> *"A good number of faculty have been trained in various aspects of One Health teaching and there is now capacity to deliver meaningful One Health training. For instance, someone who originally taught microbiology from a traditional perspective is not teaching it the same way after receiving training in how to integrate One Health in the same content. It becomes very different,"* ***Faculty, University of Nairobi - Kenya.***

> *"We have learned how to do curriculum well; I used to take it for granted. How to organise curricula - everybody should know about it. Negotiating how to integrate content. We had to call in government officials to talk about why it is important to integrate; the National Council for Technical Education (NACTE) for lower-level curricula reviews was engaged very squarely. We also involved the Tanzania Commission for Universities in reviews of the university-level curricula,"* ***Faculty, MUHAS - Tanzania.***

By investing in the retooling of faculty, institutions can better equip educators to instil a One Health mindset in the next generation of professionals, preparing them to tackle the complex health challenges that transcend traditional silos.

With technical guidance from AFROHUN Secretariat, the universities of all the initial five member countries under EPT1 and two additional new countries under EPT2 were able to incorporate One Health core competencies in the existing curricula or even develop new degree programmemes that were One Health-orientated. These efforts were more compliant with the international health regulations by the World Health Organisation (WHO) and the performance of veterinary services by the World Organisation for Animal Health (WOAH). This process was intended to make learning more relevant to the worldwide changes in the trends and patterns of the diseases and ecosystem resulting from globalisation, population explosion, increased easy travel, agricultural intensification, population explosion and climate change.

Faculty exchange visits

Faculty exchange visits were a major approach for building capacity among faculty who were supporting AFROHUN work at their respective institutions. For example, in 2016, faculty from Kenya (Moi University and University of Nairobi) visited AFROHUN Rwanda

to learn from the Rwanda faculty how to organise One Health Demonstration Site Field Attachments, how to organise Global Health Case Competitions and IDM simulation exercises. Similarly, when AFROHUN Ethiopia (Jimma University) was starting their first One Health Demonstration Site Field Attachment in 2017, a faculty from Mekelle University (where the same activity had been running for a few years) was enlisted to support the exercise. The support included training faculty supervisors for the activity (7,25,26).

Developing and strengthening curricula

Various curricula for master's degree and bachelor courses were either developed or strengthened, which included Master of Public Health, Veterinary Preventive Medicine and Public Health, Environmental Health, Field Epidemiology, Laboratory Sciences, One Health, Zoonosis, Food Safety, Antimicrobial Resistance, Wildlife Health, or Medicine. In the case of Kenya, dual degree programmeme of Infectious Diseases and Global Health was developed across the partner institutions. Competencies like OH leadership, teamwork and collaboration, outbreak investigation, risk communication, and risk analysis were introduced into the curricula reviewed or developed.

Below are some country experiences related to the development and rollout of new training programmemes.

- The University of Lubumbashi in the DRC developed two new programmemes, the Master's programmemes in 1) Wildlife Veterinary Medicine and Ecotourism and 2) Applied Epidemiology for Domestic Animals and Wildlife, to cater for the gap in capacity in those disciplines. The team used a step-wise approach to building the programmeme, starting with building faculty capacity for the programmeme using the Sokoine University of Agriculture and the College of African Wildlife Management in Mweka, Tanzania, which were already in the network. The two seed faculty trained were already interested in wildlife research and included a senior and a junior faculty.
- In Senegal, in preparation for the opening of the 'Management and Health Surveillance of Wildlife' programmeme during the academic year 2017- 2018, faculty were trained in Methods of Pedagogical Design of Modules for the Teaching of Epidemiology and Pathology.
- For the e-learning training in Tanzania, the programmeme took on a holistic approach, skilling the faculty, students on the distance education programmemes, the IT staff, administrators as well as off-site student supervisors. This ensured that everyone involved in the management and delivery of the programmemes was on board and knew what the expectations were.

Experiential learning approaches

In the context of pre-service training for One Health professionals, experiential learning is a transformative approach, moving beyond traditional teaching methods by immersing learners in real-world experiences. This dynamic framework encourages active engagement and reflection on hands-on encounters, fostering a profound understanding of the interconnectedness between human, animal, and environmental health. Experiential Learning also typically carries elements of lifelong learning and continuous improvement.

This section explores the experiential learning approaches and the overall impact of experiential learning in preparing a versatile and skilled cohort of One Health practitioners ready to navigate the complexities of the global health landscape (7).

Experiential learning teaching approaches in AFROHUN member institutions majorly include One Health Demonstration Site Field Attachments, Global Health Case Competitions, Hackathons, Outbreak Response and Investigation, Tabletop Simulations, and Community Outreaches (through Student One Health Innovations Clubs) (32–34).

Overview of the One Health Demonstration Site field attachment

One Health Demonstration Site Field Attachments are conducted in carefully selected sites that must meet a certain criterion. The factors that determine the designation of sites as One Health Demonstration Sites for field-based training are many and varied across the network. However, the key is that the site must be able to provide a unique One Health learning experience for the students. Typically, the sites present an eclectic mix of wildlife, livestock, environment and human activity (32,35). For example, the Amboseli ecosystem in Kenya consists of six Maasai group ranches with a combined area of 5583 km2 and Amboseli National Park, whose area is 390 km2. The delicate interaction between the Kenyan human brand (the Maasai), wildlife, livestock and the environment make Amboseli a fragile ecosystem and an ideal training site for One Health. The area has been grappling with prolonged dry seasons and erratic rainfall due to changing climatic conditions, severely impacting both the residents and wildlife. The changing climate led to the death of livestock during dry periods, prompting some residents to turn to irrigation-fed farming to diversify their livelihoods. This shift increased competition for scarce water resources between livestock and wildlife, exacerbating the existing challenges. The residents invaded game parks for pasture, while wildlife encroached on people's farms, resulting in a cycle of human livestock- wildlife conflict.

Kenyan students engage community members in the Loitoktok ecosystem during their One Health Demonstration Site Field Attachment. Students are from different disciplines which enhances their learning experience. In-set (Left) is Akagyera National Park in Rwanda and (Right) a young woman collects charcoal in Loitoktok in Kenya. Source: AFROHUN Kenya archives.

Evolution of the One Health Demonstration Site field attachment

Between April to May 2013, AFROHUN Uganda conducted the very first One Health Field Experience learning (FEL), at the time referred to as One Health Field Attachment, for a team of 50 students picked from the disciplines of Veterinary Medicine, Environmental Health, and Nursing. The purpose of the joint attachment was to expose the students to the practice of one health, create an environment for the students to improve their communication skills, afford the students opportunities to enhance their disciplinary skills and provide an opportunity for the students to learn how to identify community problems and categorise them appropriately on how they could deal with them. The OHFA lasted for four weeks, and students were kept within selected communities previously identified to have 'wicked' One Health challenges. Such communities were referred to as One Health Demonstration Sites (often shortened to DEMO sites), and the 'wicked' One Health challenges were those that involved humans, animals, and the Environment. The 'demo sites' in Uganda were centred around districts that had domestic animals and wildlife interfaces (32).

The process involved pre-visit training as well as field-based learning for both the faculty and students. The pre-field visit involved intensive class-based training to equip students with essential skills. Topics covered included the Introduction to One Health Concept, Systems Thinking, Infectious Disease Management, Community One Health Needs Assessment, Stakeholder Analysis, and more. This training aimed to prepare students for the multidisciplinary approach required in addressing complex One Health issues. During the four weeks of field attachment, the students, under the supervision of faculty and guidance of field-based personnel, engaged in activities around determining, categorizing and prioritisation of One Health challenges. They then designed and implemented relevant

interventions to the prioritised One Health challenges that were within their means and finally reported and disseminated their findings to the communities. This general approach was generally adopted by other OHCEA member countries, with major variations occasioned by the various realities of the different partner implementing institutions and is still the template that is used.

Following the inaugural OHFA training in various countries, several evolutions of the FEL approaches were registered over the years in the way the training was delivered. Some of the changes that were done included the expansion of the disciplinary representation of the teams to account for the arts and social science gaps that were identified, making it a requirement for all supervising faculty to undertake a retooling course in One Health and optimisation of the One Health theoretical principles among other changes.

In 2017, the OHCEA Secretariat at the regional office realised that there was a lack of uniformity and conformity when it came to OHFA, sometimes referred to as simply 'attachment' or demo site training, depending on the countries involved. By this time, other countries, including DRC, Senegal, Kenya and Cameroon, had also started similar trainings, but ran largely in different formats. For example, in DRC, the training was a non-residential training with two days in the classroom and three field days (36,37).

A concern was then raised about defining the One Health workforce products and the key competencies that they were going out with. A process to create a guide that member institutions would follow was therefore instituted, and a team of representatives from various member countries were constituted to design and implement the One Health Field Experiential Learning (TOHFEL) Guide (8,38).

This facilitator manual provides an aligned process and curriculum for student field attachment to demonstration sites. It incorporates regional commonalities at the One Health intersection, thereby providing a standard guide that could be adapted to each country based on country-level needs.

Students watching birds as part of the experiential learning training phase related to environmental conservation in Saint Louis region, in May 2024. They are under the supervision of the National Park agents. Students are from 6 public universities of Senegal (UCAD, UGB, UADB, UIDT, USSEIN and UASZ) in the disciplines of veterinary science, agronomy and zootechnics, human medicine, sociology, community health, environmental sciences, forestry. Source: AFROHUN Senegal.

Students implementing risk communication on rabies and avian flu in localities surrounding the Djoudj National Park as part of the experiential learning training phase related to risk communication and community Saint Louis region, in 2024. Students are from 6 public universities of Senegal (UCAD, UGB, UADB, UIDT, USSEIN and UASZ) in the disciplines of veterinary science, agronomy and zootechnics, human medicine, sociology, community health, environmental sciences, forestry. Source: AFROHUN Senegal.

Student One Health Innovations Clubs (SOHICs)

Why Student One Health Innovations Clubs were started

The use of experiential field work for training students proved a popular and highly effective method for pre-service training. Both the students and the communities impacted had lots of praise for the initiatives. However, it was soon realised that a structured course of field experiential learning offered during one operational window on the university calendar was not sufficient to deliver the required volume or numbers of university students orientated in the One Health aspects.

A rapid method for the assimilation of students into the One Health agenda was to allow them to form student clubs under a patron and conduct debates, keynote talks, presentations, and community outreaches using a service-learning model to reach out to more students with the One Health concept. Easy-to-reach opportunities like regular community-driven canine rabies vaccinations, tree planting, and AMR sensitisation campaigns were undertaken. The SOHICs, therefore, offered an extracurricular environment for student engagement in mainly hands-on, community-engaged outreach activities and practical team-based learning exercises, which enhanced their appreciation and understanding of the need for multidisciplinary collaboration (31,39).

Currently, there are 18 SOHICs in all the AFROHUN member institutions and affiliate institutions. SOHICs have become a popular way of engaging students, and institutions that are not members of AFROHUN have adopted them with the support of AFROHUN staff in the respective countries. The diagram below, Figure 3.2, provides more information on the SOHICs and where they are located.

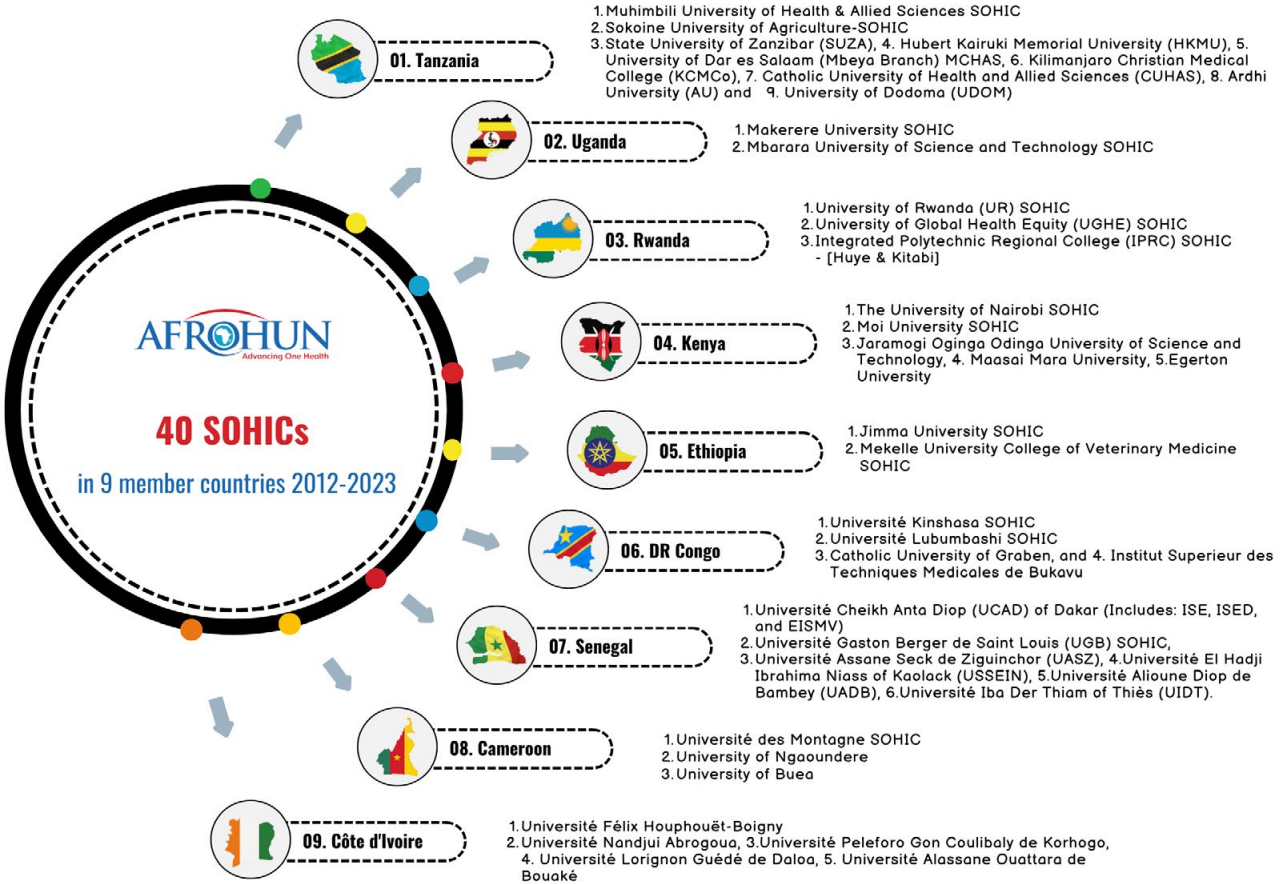


Figure 3.2: Coverage of SOHCs across AFROHUN Countries.

The objective of the SOHICs, which are also self-organising spaces where One Health leaders are developed and nurtured in the multidisciplinary and multisectoral space, was to bring together students on one platform in a collaborative effort to:

i) Promote the One Health approach through community health activities

ii) Create intersectoral and multisectoral collaboration for health improvement

iii) Share knowledge and exchange ideas on health-related issues and

iv) Participate in and support programmemes that endeavour to reduce diseases at the human, animal, and environmental interface.

The first SOHIC was formed in 2012 at Makerere University in Uganda, following the participation of students in a canine rabies vaccination drive led by the Uganda Veterinary Association. The students from different disciplines in public health and veterinary medicine felt that after understanding the One Health concept, they were empowered to mobilise other students and engage in community-based activities under the guidance of members of staff or a patron (32).

This initiative was followed by students at the University of Nairobi in Kenya and the University of Rwanda in Rwanda in 2013. Gradually, the concept of the SOHICs expanded to other universities and schools in the AFROHUN network. Eventually, SOHICs grew beyond the AFROHUN University Network to include new clubs established in primary schools and universities outside of the AFROHUN network.

Organisation and Governance of SOHICs

In the third year of the implementation of the OHW project, the OHCEA Board of Directors agreed to rename the students' clubs SOHICs to infuse the innovations component. They were previously loosely referred to as Student Clubs or Student One Health clubs, among others. SOHICs provide students with space to self-organise, learn and connect to where challenges that offer learning opportunities are (39). Clubs are created and governed by the students themselves. They plan their activities and raise funds for activities that are not supported through AFROHUN budgets. They work a lot through partnerships.

SOHICs are a starting point for opening the minds of new university students, opening them up to possibilities they had never imagined existed. For many students, the value added by being a part of the SOHIC is actively understanding each other's discipline and appreciating what other disciplines bring on board in addressing challenging health issues. Initiating them into the clubs in the first year at university, therefore, ensures that they get firmly entrenched in the One Health mindset.

The SOHIC Manual was developed in 2018 and reviewed in 2020 to integrate the evaluation of competencies that guide the effective establishment and operations of the SOHICs (39). The guide promoted gender equity and ensured the multidisciplinary nature of the club.

Traditionally, SOHICs engage in debates and seminars on different topics, community outreaches, advocacy and policy engagement, among other issues. Student debates on the role of different professionals in managing public health problems were a significant

way of rapidly getting them to understand the One Health approach, for instance. The debates played a pivotal role in facilitating comprehension of the One Health approach by encouraging active and critical engagement among learners. Lately, the SOHIC are organizing 1–2-day conferences where they share what they are learning with national, regional and global level stakeholders.

Global Health Case Competitions

Global Health Case Competitions are a high-level approach to training the One Health workforce. When done right, the competitions heighten students' understanding of issues of national, regional and global interest and concern. They bring together students from multiple disciplines to propose innovative ideas and solutions to a provided case on a complex health challenge (40). The groups compete against each other for the best, most practical and most innovative solutions to the case. Faculty have been responsible for developing the cases and mentoring students throughout the process.

The process of preparing for Global Health Case Competitions catapults students into leadership roles, thinking on their feet, working in teams, and problem-solving environments with great mentorship from faculty. Among the many experiential learning approaches, Global Health Case Competitions are believed to build several competencies, including conducting One Health inquiry, Leadership, Teamwork and Collaboration. It is, therefore one of the good practices in building a competent One Health workforce.

Global Health Case Competitions were first introduced to Rwanda by the One Health Workforce Global Team led by the University of Minnesota. From Rwanda, the approach spread to Kenya and Cameroon, while the Secretariat has organised several episodes at the regional level. Global Health Case Competition design and evaluation questions ensure that soft and hard competencies expected to be gained are adequately assessed (37).

A team of students from Université des Montagnes, Cameroon competing with 4 other teams in a regional Global Health Case Competition during the 3rd OHCEA International One Health Conference in Kampala, in 2019. The team came 3rd overall. Source: AFROHUN Secretariat archives.

A team of students from Kenya (University of Nairobi and Moi University), participating in the same competition. They Kenya team won the competition. Source: AFROHUN Kenya archives.

University of Rwanda faculty work in small groups during a training on designing case studies on One Health and D) Faculty in the workshop post their thinking on flip charts using Stick-It notes. In photos B and C, University of Jimma faculty and Mekelle University faculty participate in curriculum review and One Health integration workshop. Source: AFROHUN Rwanda archives.

Critical evaluation of the impacts of AFROHUN's pre-service training initiatives

This section deep dives into the contributions of the pre-service training efforts and how these were realised. The experiences shared here are from data that has been collected over the years in different ways: pre-training surveys, interviews, post-activity surveys/evaluations, alumni tracking surveys, one-on-one interactions, and self-documented testimonies.

The Kirkpatrick evaluation model (22) also informs the assessment of training at four levels, including learners' reactions, learning outcomes, behavioural performance, and results (organisational outcomes) (23). Below, we reflect on the results at the various levels of learning.

Learner's reactions and learning outcomes

The acquisition of skills by the participants who attended the short course training where One Health competencies were delivered was done using pre- and post-training quizzes. Later, at the country level when lecturers were more versatile with the One Health teaching, there were assignments, group work and tests to evaluate competencies given. The students, on the other hand, were happy with the way the lecturers delivered the modules.

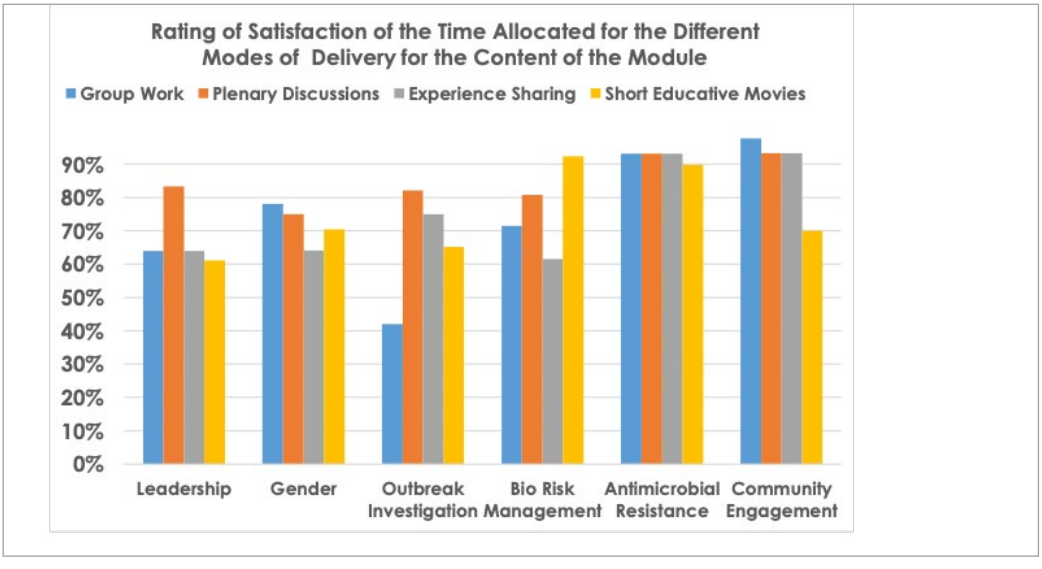


Figure 3.3: Snapshot showing the degree of contentment given by a group of students at Makerere University One Health short course orientation in 2017.

Testimonies from participants on the Short Courses

The evaluation of learning indicates changes in knowledge and skills relating to one health as a concept, approach and practice. The respondents highlighted improved understanding of the interdependencies among professionals to advance health holistically.

> *"I knew that matters concerning health were only worked on by different groups of people like clinicians, lab technicians, medical doctors, and nurses. I want to thank the One Health Institute for opening a gap for me to change my mind set about this. I appreciate it so much that I have been able to learn more about health and the concerns of One Health in general, where I look forward to applying all the acquired knowledge from the theoretical training". (2017, Participant from College of Business and Management Sciences, Statistics)*

> *"Until I went through the module 'Gender Associated Risk Management', I had no idea gender played such a big role in any outbreak or community health. Now I know better to analyse the gender influence in a situation before choosing a focus group." (2017, Participant: College of Computing and Information Systems, BSc.Software Engineering).*

Social scientists revealed an appreciation of the contribution of their disciplinary knowledge and respective roles in health advancement especially during epidemic management. They emphasised the need for cooperation, teamwork and communication arrangements to steer multidisciplinary collaboration in health.

> *"In matters of leadership in infectious diseases, I had no idea that I had a role to play in an outbreak. I thought my role as a social scientist was doing research and bringing back the data gathered to people who sent me. Still, now I know that I have a role to play with other fields to ensure that we not only detect and prevent the disease but also respond to it through establishing various interventions. To achieve this, there is a need for teamwork and effective communication between teams and when there is an outbreak how you can communicate the risk." (2017, Participant from College of Social Sciences)*

The training catalysed relationship formation as individuals made new friends across disciplinary boundaries. Friendship was considered the foundation for cooperative actions and collaboration in addressing health challenges using the one health approach.

> *"During the training, I met a group of totally new friends from different disciplines and became a family of One Health with such a metallic bond among ourselves, something again very fascinating. I was initially wondering how people from multiple disciplines could work together." (2017 Participant: College of Agriculture and Environmental Sciences).*

The positive reviews of the capacity building efforts also extended to other modes of learning beyond the formal in-class training. A student in DRC ably summed up the kind of experience students undergo during the immersive field attachment.

> *"Demo sites expose us to real-world issues, and it is interesting to see how students behave when they face these issues. People are thinking on their feet – interesting to see. We have acquired key competencies. You are actually dealing with real challenges and making decisions that are real, not just role play. Working with the biggest part of the population – illiterate, poor, etc. is complex, requiring a complex mix of competencies," Student, University of Kinshasa – DRC.*

Spotlighting competencies for enhanced behavioural performance

This section takes a look at how the training how translated into competencies and how these competencies have been applied in real-life work situations. The impacts presented under the respective competency domains are just a sneak peek into the broader impact

that AFROHUN has had through its pre-service capacity development initiatives.

Competency Domain: One Health Epidemiology

Under this competency domain, students should be able to bring One Health thinking to public health problems and challenges in order to solve them comprehensively (19). The ability for students to look at a public health problem and be able to investigate it, thinking beyond what is commonly known about the problem as a public health issue. This student from Rwanda illustrates the learning and acquisition of these competencies quite well.

> *"We visited Kagyeyo, and we found out that people there drink water with a high quantity of fluoride. They have dental fluorescence in young children. We realised that the problem comes from water with high fluoride content. We need those people in water treatment to treat water in order to reduce that fluoride. We need nurses and doctors to treat them but with an informed source of the problem, because sometimes they think that people drink hot water or eat hot potatoes and that is what changes the colour and texture of their teeth…," **Student, University of Rwanda – Rwanda.***

Competency Domain: Ecosystem Health

Ecosystem Health, among other things, requires students to be able to recognise the inter-relationships among animal health, ecosystems and human health. Several efforts demonstrate the hands-on application of knowledge to address complex health challenges arising from the ecosystems.

In August 2016, students in Uganda attending a One Health demonstration site field attachment in the western district of Kasese identified bat infestation as a big One Health challenge to the community. Bat infestation was a problem in the whole community around Kahendero Primary School. The primary schools, churches, Kahendero Health Centre II, individual households, and the entertainment centre were heavily infested with bats. While the conventional method of dealing with bats is to fumigate against them and dispose of the dead bats, the team of students came up with an eco-friendly bat repellent formulated using ethanol to extract cinnamon and eucalyptus oil from eucalyptus bark. The students effectively repelled the bats from the primary school by using this cheap, safe, locally available, and eco-friendly repellent formulation (32).

In another instance, students have worked with communities to come up with eco-friendly strategies for dealing with waste. These include making briquettes from the huge amounts of waste from markets.

With the ever-escalating demand for wood fuel and the implications this has on the environment and the economy of the country, this was a good use of the competency picked from the immersive field trainings.

With the ever-escalating demand for wood fuel and the implications this has on the environment and the economy of the country, this was a good use of the competency picked from the immersive field training.

Competence Domain: Outbreak Investigation and Response

By taking part in disease outbreaks, students receive an all-round education that they are able to apply in their various careers (8). Several cohorts of students across the network have had various opportunities to take part in both small, localised disease outbreaks, like cholera, as well as large scale outbreaks like COVID-19 (36,37). Experiences shared indicate the capacity built that has been demonstrated through how the students have transferred this to work situations.

The goal of this training approach is to develop a capacity for outbreak investigation and response that merges animal, human and environmental health knowledge and capacities to support comprehensive disease detection and control at international, regional, national and sub-national levels. The training strategy requires multidisciplinary field-based training that constitutes engagement with communities.

The modules of the training for outbreak response and investigation focus on the following One Health approaches: disease surveillance, field investigations, leadership, applied epidemiology, data analysis and interpretation, outbreak response, communication, risk assessment, basic socio-economics, participatory methodologies/community engagement and monitoring and evaluation.

Zoonotic diseases such as Ebola Viral Disease occur as a result of the complex interactions that occur at the animal-human-environment interface. Strengthening cross-sectoral collaboration is vital to detect and respond to infectious disease outbreaks. The most obvious implication is the need for the health sector to partner with institutions in relevant sectors like the Ministries of Livestock, Ministries of Environment, Ministries and Authorities of Wildlife, departments of Disaster Preparedness, and other sectors appropriate to the context. However, re-aligning training to this paradigm shift is even more critical and urgent.

Ugandan students have probably benefitted the most from this training approach, given the many small scale and medium scale disease outbreaks that the country has experienced. Because of the multidisciplinary composition of the teams, students have been able to look beyond the health effects of outbreaks and assess the economic effects on local economies as well. A few examples from Uganda stand out (27,32,41,42).

- In the 2016-2017 Highly-pathogenic Avian Influenza (HPAI) outbreak, students were able to interact with local poultry farmers and assess the effect of the outbreak on their businesses.
- The 2017 Marburg Virus Disease outbreak in Kween district, Eastern Uganda, had cross-border dynamics that provided students with unique learning about community hostility that came with 'unexplained' death.
- During an Anthrax investigation in Arua district in 2017, students working with sub-national health officials engaged communities to assess priority diseases in terms of their impact. This exercise equipped them with the necessary tools for participatory epidemiological investigation, e.g., rural/rapid participatory appraisal skills.

The ongoing mentorship on community engagement provided students with knowledge and skills in sensitisation of communities on infection control and prevention of further

spread of the outbreaks (8,31). Students are also able to engage and work with sub-national and national-level structures that are in place to respond to outbreaks. This is invaluable to harness learning from broad experiences from different contexts. Students also experienced first-hand the structural challenges that investigation teams face in such outbreaks; the poor road infrastructure, use of vehicles not made for hard-to-navigate hilly terrain, inadequate hospital facilities, supplies and human resources for health. They also observed the absence of other structures necessary for the management of such outbreaks (7).

In 2016-2017, Uganda experienced an outbreak of Highly Pathogenic Avian Influenza that killed both wild and domestic birds. In this photo students of Makerere University dissect a dead Chicken as they participate in an investigation of the outbreak in Kalangala district in Uganda. Source: AFROHUN Uganda archives.

Generally, students' engagement in outbreak response and investigation exposed them to real-life health emergencies. It provided an opportunity for developing key One Health competencies relevant to their real-life contribution to effective epidemic management and control. The quotes below affirm:

> *"As a student, I had never participated in an epidemiological study. I did not know how to investigate an outbreak, but I thank OHCEA for giving me this opportunity to be part of this great team, which is helping me to learn a lot, because we are working with professionals. I appreciate the one health approach of solving health challenges because a doctor, nurse, veterinary doctor, or health worker could not manage to investigate outbreaks without the help of other disciplines", a Student of MMB.*

> *"The investigation was very informative and educative. I was blessed to find out a lot about zoonoses. As a public health student, I had no knowledge about zoonotic disease but I got the chance to work with experts in the area; it was eye-opening to me. I got a chance to interview cases and interact with the community and different stakeholders, DHOs, village leaders and other people in the community. This opened my mind in terms of infectious diseases, and I thank One Health (OHCEA) for the great opportunities it gives students to engage in such activities", Masters of Pubic Health student, Makerere University.*

Competency Domain: One Health Leadership

One Health Leadership, as a competency domain, enables students to view everyone as a collective contributing to the same vision. One is able to mobilise others and create a shared understanding for a common cause, and one can lead others through mentorship and other methods (21). Competencies gained in this domain were crucial for students to lead themselves out of the AFROHUN confines and seek partnership and funding opportunities elsewhere, which is important for sustaining momentum. The SOHICs were central in shaping these capabilities, as the quotes from student leaders across various SOHICs affirm below:

> *"The SOHIC gives us space to innovate, to initiate things, to think on our own. We contribute 2000 CFAs every quarter to support activity implementation", student, UdM – Cameroon.*

> *"So, another thing I have learnt a lot in OHCEA is leadership. When they give you a case or something to tackle, it makes you think, then you become a leader at that time, and you take a decision. Decision-making in OHCEA is something that I have learnt a lot," student, University of Rwanda – Rwanda.*

> *"I gained a lot of experience because by leading such a club with many members. I was able to understand how to handle people and it was also a good opportunity to get skills on how to interact with people," student leader, MUST – Uganda.*

> *"My university and my course that I have been doing made me ready for dental practice, but One Health has made me ready for the world because it has enhanced my leadership skills," Student, Moi University – Kenya.*

Competency Domain: Systems Thinking

Multidisciplinary education is meaningful, comprehensive, and enriching to the students (43). Many students attest to how it has changed the way they look at the world by studying and connecting dots in the system, stepping out of what they know from book knowledge, how they gain a whole new understanding of health challenges and how they engage in decision-making.

> *"I think they are offering unique courses; for example, 'Systems Thinking', that is something I never heard about, so it was something interesting because I was able to understand how to think differently, how to approach issues differently, you will realise that especially the health sector- the health system itself is a wicked problem. So, through the courses you can understand the complication, how complicated the health system is, and you can understand how best you can be able to approach it," **Student, Moi University – Kenya.***

> *"It has nurtured me to think bigger than I used to think before. I have come to realise that a problem does have various entry points. It may be a health problem, but the entry point may be culture or gender or even politics and policy," **student, MUST – Uganda.***

The systems thinking lens was central in justifying the need for multidisciplinary teams in One Health (44). One student observed that learning about systems thinking helped them appreciate the limitations of teaching and learning as single disciplines at the University.

> *"The university teaches in silo mode - but we are now more in systems thinking after the exposure to other disciplines and what they do. For AMR problem, it is a whole chain of events which requires systems thinking; all professionals contributing". Student, University of Lubumbashi – DRC.*

Some students went ahead to apply systems thinking in their own academic and professional work aligning with Kirkpatrick's level of results (22).

> *"The training we underwent in systems thinking has made it easy for me to do a research project that we did recently on occupational health and safety and health of fishermen, so I was able to relate everything and come up with recommendations. It opens up your mind in a way that you begin to appreciate the different players when it comes to occupational health and safety so you are able to reach a wider team of respondents than you would otherwise before the training," **Student, Moi University – Kenya.***

> *"I am from medicine, and I have worked a lot with (Mariam), who is a student of gender. You get a different kind of feel for the issue you are dealing with. When you are all from the same discipline, you tend to think the same way, in the same direction. For example, in the Climate Change trainings that we have been conducting, the students of Gender brought in a gender perspective to climate change that many of us would not have thought about. This changes the way interventions can be designed," **Student, MUST – Uganda.***

Competency Domain: One Health Research

One Health Research is still in the nascent stages in most parts of Africa (45). AFROHUN training activities have exposed students to research opportunities, especially through the One Health Demonstration Site Field Attachments and the Global Health Case Competitions (36). A detailed expose of developments in the AFROHUN Research docket is available in Chapter 5. Here, we share a few experiences shared by the students and faculty mentors.

> *"Currently, I am involved in a research study aiming at establishing the presence of antimicrobial resistance in children from an urban set up and the risk factors involved. My project is using a One Health approach whereby I want to establish whether domestic animals are the source of these microorganisms and also see if food and water could be the route through which these organisms are passed to the children. The skills I acquired as a One Health active member have been really useful throughout this journey. They have empowered me to be a better researcher',* ***Student at Makerere University – Uganda.***

> *"I have also seen from these One Health Demonstration Site Field Attachment activities the single activity where students have been able to generate data and write papers and present to conferences locally and internationally. I think it is a game-changer in terms of research for our students both here and at the University of Nairobi,"* ***Faculty, Moi University – Kenya.***

> *"We wrote a paper from my 1st field attachment, and I presented it in Nigeria at a conference – it provided me a platform to interact with other Africans and discuss One Health. It gave me a whole new perspective. I also worked with other people to write a project on Climate Change after participating in the field attachment,"* ***Student, MUST – Uganda.***

Competency Domain: Communication and Informatics to support policy advocacy and change efforts.

The use of visuals, graphic presentation of complex concepts and data, and the ability to break down technical issues into a language and format that different categories of people find easy to digest is a key competency in One Health practice. AFROHUN has organised several activities that provide students with space to innovate and simplify using professional communication principles and available technologies. The student's story below illustrates the development and application of competencies in communication.

Alumni Experiences and voices: demonstrating long term results and contributions to organisational performance

Insights from the Alumni tracking survey

In 2022, AFROHUN mounted an online alumnus tracking survey under the objectives of USAID's One Health Workforce Next Generation project. The survey tracked where the alumni are, how they have applied competencies gained from One Health training, and their emerging competency needs that may inform the review of existing programmemes and the design of new ones. Although the survey attracted less than the expected numbers, it provided. Overall, alumni responded positively about their programmeme experiences and application of what they have learned post-programmeme. The experiences shared by alumni reveal the efficacy of AFROHUN One Health training activities and programmemes in building their career paths.

Figure 3.4: Impacts of respondents' experiences of One Health Training

With the majority employed by the government (45%) and education institutions (30%), e.g., universities, alumni have applied One Health competencies that have influenced workplace practices and how they have addressed challenges around their work.

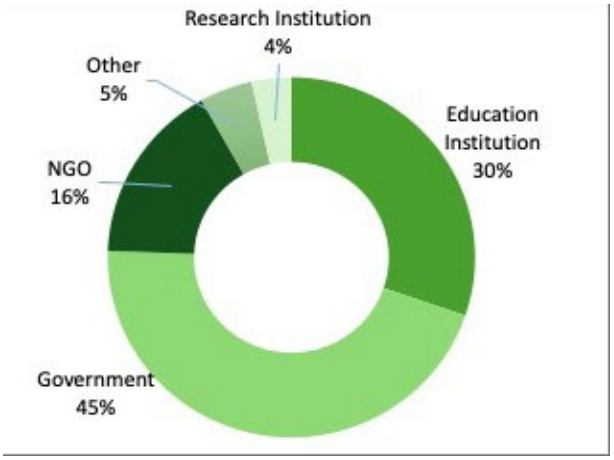


Figure 3.5: Employment status of current alumni

Profiling the emerging young One Health champions in Africa

In a related exercise, AFROHUN embarked on systematic profiling of some alumni to reflect on their life trajectories and growth through AFROHUN's initiatives, especially the SOHICs.

The examples below demonstrate that the blend of personal initiative, structured capacity building efforts and conducive supportive environments have fostered the emergence and growth of young One Health Champions across the AFROHUN network.

1) Dr. Jean Paul Mushayija: A One Health advocate and Change agent at Workplace and Beyond in Rwanda

Dr. Jean Paul Mushayija, a veterinarian based in Kigali, Rwanda, embarked on a transformative journey in One Health (OH) after training with AFROHUN. His experience equipped him with innovative approaches and deep insights into the interconnectedness of human, animal, and environmental health systems. Joining the FAO in Kigali, Jean Paul championed One Health principles, fostering collaboration to address public health challenges. Despite challenges, his perseverance and advocacy led to significant changes within the FAO and beyond, influencing peers and the community alike through lectures and workshops. Today, Jean Paul Mushayija is celebrated as a leading One Health advocate, inspiring others to embrace collaborative solutions for global health challenges.

2) Dr. Nickson Lang'at: Spearheading impactful one health initiatives, showcasing leadership and collaboration skills across diverse disciplines.

Dr. Nickson Lang'at's academic journey and career trajectory have been profoundly shaped by his involvement in the Student One Health Innovation Club (SOHIC). His passion for public health flourished through active participation in club activities, where he gained insights into the interconnectedness of diseases affecting both animals and humans, and their environmental implications. Leading the SOHIC as president, Dr. Lang'at spearheaded impactful initiatives such as rabies vaccination campaigns and efforts against jiggers, showcasing his leadership and collaboration skills across diverse disciplines. These projects underscored his dedication to holistic health approaches, including partnerships with national parks to mitigate infectious diseases through student engagement. Combining

his background in Veterinary Medicine with experiences from the club, Dr. Lang'at pursued advanced studies, including a Master of Science in Environmental Governance, and is currently nearing completion of a Master of Public Health at the University of Edinburgh. His research focus on zoonotic diseases within the One Health framework reflects his commitment nurtured by the SOHIC. Dr. Lang'at credits the SOHIC for catalysing his research interests and career aspirations in addressing complex health challenges at the intersection of human, animal, and environmental health.

3) Protus Musotsi: Leveraging One Health background to coordinate research projects and mentor future One Health leaders

Protus Musotsi began his One Health journey as a student at Moi University, where he co-founded the Student One Health Innovation Club. This initiative proved pivotal in shaping his academic and professional trajectory. Currently serving as a Research Project lead at Sentum Scientific Solutions in Kenya, Protus has leveraged his One Health background to coordinate research projects and mentor future One Health leaders. His involvement in One Health activities, from organising field outreach to leading research initiatives, underscores his commitment to interdisciplinary collaboration and community engagement. Protus Musotsi's story exemplifies the transformative impact of One Health education and its role in shaping future health interventions and academic models across Africa.

4) Given Shedrack Sam - Tanzania

Given Sam's motivation for joining One Health training was driven by a passion for community work and outreach. Her transformative experience in the 2020 Rabies Vaccination Campaign in Kisarawe, facilitated by the Global Alliance for Rabies Control (GARC), helped her gain skills in rabies education and community coordination. The AFROHUN Transition Award Grant further enhanced her skills and expanded her professional network, deepening her understanding of health challenges, particularly rabies. These experiences have significantly shaped her expertise and commitment to addressing health issues. As an Environmental Health Scientist, she emphasises the importance of collaboration across medical, veterinary, and environmental fields. The One Health training provided her with essential teamwork and leadership skills, leading to recognition as a Global Rabies

Awareness Champion in 2021 and as an Outstanding Youth in Health Care Advocacy in 2023, demonstrating the impact of the training on her career trajectory and success.

5) DAHOUROU Laibané Dieudonne – Veterinary Epidemiologist, international civil servant - Senegal

What catapulted Dahourou to being where he is today is his willingness to learn about One Health, join an international network (AFROHUN) and contribute to the implementation of One Health programmemes in Senegal. *"There has been a lot of learning about One Health and this has had an impact on our approach to managing OH-related situations"*, he says.

The AFROHUN training and skills gained have enabled him to integrate easily into One Health environments. In addition, the skills acquired in curriculum development and pedagogical engineering continue to serve him and colleagues well in their professional activities.

He has contributed to the designing of training curricula, case management of illnesses using the One Health approach, among other areas of impact.

6) Titi Messembe

Dr. Titi Messembe's motivation to join and participate in AFROHUN activities stemmed from her belief that collaboration between different disciplines, such as veterinary medicine, public health, and environmental science, is essential for achieving holistic and sustainable solutions to global health issues. The interconnectedness of human, animal, and environmental health requires a multidisciplinary approach, and AFROHUN activities provide a platform for fostering this collaboration.

The game changer for her has been AFROHUN activities that facilitated cross-disciplinary interactions and knowledge exchange. Participating in the Global Health Case Competition, being part of collaborative projects, workshops, and conferences has been instrumental in molding her as a One Health advocate. These experiences have fostered a mindset of inclusivity and cooperation, emphasizing the shared responsibility of diverse professionals in addressing health challenges. By embracing this holistic perspective, she has been able to approach complex problems with a more comprehensive and integrated mindset. Her professional growth has been characterised by the utilization of competencies built through AFROHUN activities. She has incorporated principles of One Health

into her work by developing technology-driven solutions that promote interdisciplinary collaboration, data transparency, and real-time information sharing.

7) Yimesgen Tarekegn

Dr. Yimesgen Tarekegn has always desired to understand the One Health approach and foster interdisciplinary collaboration within the university and community. The One Health Demonstration Site Field Attachment programmeme provided him with practical experience in implementing the One Health approach through community immersion with diverse teams. This exposure enhanced his understanding of the connections between human, animal, and environmental health, motivating him to collaborate with professionals from various fields.

His involvement with AFROHUN included practical training in infectious disease management, which deepened his engagement in zoonotic disease control and prevention. This training helped him secure a role as Animal Welfare Coordinator at Elnet Foundation and develop skills in community outreach, team building, and One Health implementation. Additionally, he organised a One Health Advocacy programmeme for Ethiopian universities and produced content to improve communication across disciplines.

He was the keynote speaker at the 4th AFROHUN International One Health Conference, 2024 in Nairobi – Kenya.

8) Prisca Kabangu

Prisca Kabangu has always had motivation to learn about the One Health approach, to know how the different disciplines work together to resolve questions related to public health. She was also motivated to learn and acquire leadership skills. AFROHUN support under the AFROHUN Transition Award allowed her to do her professional internship at Breakthrough Action in 2023 on Risk Communication and Community Engagement (RCCE); an important learning experience and practical understanding of everything she learned during the time she was a student.

"I stand proud and I feel I am a different communications professional from others who didn't have the opportunity to train in the One Health approach. I can practice thinking and carrying out activities in a multidisciplinary, multisectoral environment. I also learned to be a good leader and work for the good of my community. I am a professional, capable of

working in a multicultural setting, and I take great care in how I communicate. I know we can lose many lives if we do not communicate effectively", she shares.

Prisca occasionally provides communication support to AFROHUN DRC Country Office.

9) Doreen Birungi

In her hometown in Uganda, Doreen Birungi observed the impact of animal-origin diseases like Rift Valley Fever (RVF) and Anthrax on pastoralist communities, including the death of a breadwinner due to RVF. Inspired by this, and mentored by Prof. Majalija Samuel of Makerere University College of Veterinary Medicine, Animal Resources and Biosecurity (COVAB), she championed the creation of Uganda's first One Health Students Club at Makerere University. The club, comprising students from various disciplines, began community sensitization efforts at nearby slaughterhouses and communities.

Doreen also led the STOP Spillover project in Uganda, funded by USAID, which focused on the bat-human interface and the risks of zoonotic viral spillover. This project highlighted how food insecurity can contribute to disease spread, leading to the formation of One Health Design Research and Mentoring (OHDREaM) groups to identify infection nodes and promote interdisciplinary collaboration.

Currently, she is a Senior Epidemiologist and Regional Projects Officer for Eastern Africa at Amref Health Africa Headquarters in Nairobi - Kenya.

Conclusion

The emergence of the African One Health University Network (AFROHUN) is emblematic of the innovative strategies required to develop a resilient and adaptable workforce capable of navigating the complex health landscapes in Africa. By integrating One Health principles, theories and practical experiences into pre-service training, AFROHUN has initiated a paradigm shift in how health professionals are educated, emphasizing the interconnectedness of human, animal, and environmental health systems. This approach cultivates a holistic understanding and equips future professionals with the competencies needed to address multifaceted health challenges.

This chapter highlights AFROHUN's efforts to strategically align with the evolving educational trends in Africa, particularly the shift towards competency-based education. This alignment is pivotal in fostering a new generation of health professionals who possess not only the technical skills but also the collaborative mindset necessary to drive the One Health agenda forward. The analysis reveals essential capacity requirements for implementing One Health strategies effectively in LMICs. These include enhanced competencies in technical areas of

one health (such as a comprehensive understanding of the interconnected nature of health systems) and software skills, such as collaborative problem-solving and cross-disciplinary communication. AFROHUN has applied several pre-service capacity enhancement approaches over time. These include efforts to create a favourable learning and teaching environment such as curriculum review and development and faculty retooling. The second strand focused on experiential learning methods such as the establishment of demonstration sites, Global Case Competitions and Student One Health Innovation Clubs (SOHICs). These efforts have led to the development of a competent, field-ready workforce characterised by a multidisciplinary approach and a keen understanding of the One Health paradigm.

AFROHUN's strategic interventions in pre-service training have yielded positive outcomes, as evidenced by the successful integration of One Health competencies into curricula and the empowerment of students and faculty to engage in innovative health solutions and change processes at their learning institutions or workplaces after school. Critical success factors included institutional support, faculty engagement, and the alignment of educational programmemes with real-world health challenges. On the contrary, challenges such as resource constraints and entrenched educational silos have been highlighted as barriers to progress. AFROHUN's approach underscores the importance of capacity strengthening at the individual, organisational, and network levels, contributing to a holistic enhancement of One Health capabilities across Africa.

In summary, the ongoing dialogue around One Health capacity development must continue to adapt to the changing landscape of global health. The reflections in this chapter provide a foundation for future discussions and actions aimed at strengthening pre-service one health workforce development and ensuring that health professionals are well-prepared to meet the complex demands of the 21st century.

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Chapter 4

Developing a One Health Workforce Through In-Service Capacity Building

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Introduction: A strange disease in Ethiopia that took years and multidisciplinary teams to manage

In the early 2000s, a mysterious illness emerged in Tigray, a region in northern Ethiopia. This illness, which primarily affected people living in remote villages, baffled local health professionals who were familiar with the tropical diseases common in the area. The disease, later named Unidentified Liver Disease (ULD), caused swollen, painful abdomens, weight loss, and, in severe cases, difficulty breathing due to fluid buildup pressing against the lungs (1). Families were devastated as multiple members often fell ill, including children as young as five. The lack of nearby medical facilities compounded the situation, leaving residents to suffer without adequate healthcare.

Between 2002 and 2005, the disease spread, and by 2005, more than 1,200 individuals had been diagnosed, with over three hundred succumbing to the illness by 2011 (1). Recognising the urgency of the situation, a multidisciplinary team consisting of experts from the Ethiopia Ministry of Health, the Ethiopia Health and Nutrition Research Institute (EHNRI), the Ethiopia Ministry of Agriculture, WHO-Ethiopia, and local universities launched an investigation. This team, composed of physicians, veterinarians, epidemiologists, and other specialists, sought to identify the disease's cause. By 2007, infectious diseases were ruled out as a cause, leading the team to suspect an environmental factor related to the local diet.

Further investigations in 2008 identified low levels of pyrrolizidine alkaloids (Pas) in grain samples from affected households (1,2). These plant-based liver toxins were traced to a common weed that was inadvertently harvested alongside grains. Despite these findings, the toxin levels seemed too low to cause acute illness, leaving many uncertainties about the cause of ULD. Additional research conducted by the Centres for Disease Control and Prevention (CDC) and the United States Department of Agriculture (USDA) in collaboration with local institutions confirmed higher PA levels in ULD-affected households, suggesting a direct link between dietary exposure to these toxins and the disease (1). The research underscored the critical need for multidisciplinary approaches in tackling complex health issues, as demonstrated by the collaborative efforts that eventually pinpointed the disease's cause.

The challenges faced in Tigray highlighted the importance of multidisciplinary solutions to complex health issues, inspiring institutions like Jimma University in Ethiopia to embrace the "One Health" approach. As part of the founding member institutions of AFROHUN in Eastern and Central Africa in 2010, Jimma University has championed efforts to integrate One Health competencies into public health and veterinary education, underscoring the need for in-service capacity development across the African continent. This approach, exemplified by the response to ULD, demonstrates the value of collaborative, cross disciplinary efforts in addressing multifaceted public health challenges.

Why in-service training? A look at the AFROHUN approach

A highly competent in-service professional ready to address complex health challenges, as illustrated in the case above, is needed now more than ever (3). The case, a true story of what happened in the Tigray region in Ethiopia, is just one of the many pandemics and epidemic scenarios on the African continent that require competent health professionals with multidisciplinary skill sets and mindsets. These capabilities are often not acquired in traditional training institutions. In such cases, different professionals, such as health workers, plant scientists, epidemiologists, and behavioural scientists, deploy their professional technical competencies. In contrast, they lack additional soft skills such as coordination, collaboration, communication, system thinking, and the right mindset to enable them to work better together (4,5).

AFROHUN is dedicated to transforming university and other tertiary institution's teaching and learning environments as a long-term solution to produce health professionals with competencies (knowledge, skills, and right attitude) that support multidisciplinary and interdisciplinary working, otherwise known as the One Health approach in day-to-day work (6,7). The health professionals within government Ministries, Departments and Agencies (MDAs) who are already practising and often dealing with the complex health challenges on the rise, including pandemics such as Ebola, COVID-19, and antimicrobial resistance, climate change vagaries who may have missed out on One Health training during their university or other tertiary trainings which are predominantly siloed, need to be retooled to

upgrade their multisectoral working capabilities to be more effective in dealing with current complex health service delivery needs.

In dealing with this training gap, AFROHUN has an in-service training programmeme strategy to strengthen in-service professional One Health competencies. The strategy involves skilling and equipping professionals from different sectors and disciplines in practice to address capacity needs and challenges at the human-animal-environment interface, supporting practical learning and collaborative actions in the field as part of the skilling process (8,9). As an approach, AFROHUN supports in-country and regional needs-based in-service training.

With a desire to develop an integrative and dynamic health professional capable of dealing with the complexities in the world of work today, AFROHUN set out to equip in-service professionals with a range of new skill sets (10). In September 2012, professionals from AFROHUN and international experts defined a total of sixteen (16) cross-cutting and core competencies and a framework to anchor health science training around One Health principles (11,12). With funding support from USAID's Emergency Pandemic Threats programmeme under the Respond project, the 16 competencies were defined to be critical for One Health. In August 2022, under the University of California (UC), Davis led the One Health Workforce Next Generation project (13). An update of the One Health competencies was done, a total of 19 domains and several sub-domains (14) (cross ref table in chapter 3 on OH competencies) anchoring an ideal One Health education as a competency-based education by domains and sub-domains with proficiency levels from beginner, intermediate, advanced and expert (15). AFROHUN has adopted competency-based training as an ideal mode of in-service capacity building to this day (12).

In this chapter, we are focusing on showcasing selected high impact in-service One Health workforce capacity building initiatives demonstrating the role played and the impacts made by AFROHUN in enhancing in-service workforce capacity. In doing so, we spotlight the gains made by AFROHUN at the individual, institutional and system-wide levels in different countries on the African continent and the in-service capacity development model that led to these outcomes. These help us to understand how One Health competencies help deliver comprehensive health systems strengthening.

Practitioners, regional and central government officials, higher education institutions, both public and private and development partners will find value in this chapter, especially concerning the impacts of multidisciplinary or multisectoral or One Health approaches in improving integrated health systems (5,7). Across the AFROHUN countries, the model below was used to frame in-service capacity development programmemes.

AFROHUN In-service capacity building theory of change

Appreciating that the employers partly support in-service capacity building efforts, government engagement as a major employer was key from the start-up phase. As elaborated in Chapter 2, AFROHUN set up Country Coordinating Committees (CCCs) as a structure constituting all key sectors in One Health in a country with a mandate to steer one health work in a member country. The sectors represented human and animal health, environment, agriculture, internal affairs and security, local government, and the Prime Minister's office. This CCC structure was, at the time, part of the AFROHUN organogram. The CCC was key in shaping network programmemes, including in-service activities, and served as the main link for fostering working relationships between the network and policy/decision makers across the region. This ensured the delivery of government capacity-building priorities. This structure was later dissolved around 2015. With the onset of government-led in-country One Health mechanisms, the One Health Platforms and CCCs were dissolved by AFROHUN Leadership in preference for the government-institutionalised mechanism as a more sustainable approach.

Apart from the CCC structure that informed programmemes, the in-service capacity building interventions were developed in two ways: (1) in-country capacity development interventions that later were consolidated into regional capacity programmemes for scale-up and (2) regional capacity development interventions that underwent customisation at the country level. In both approaches, the processes followed a model illustrated below.

- **Participatory baseline/need assessment and gap analysis** that defined priority in-service capacity gaps and ideal target audiences.
- **Intervention design**, which involved the development of curricula and training materials for the priority one health topics.
    - **Regionalisation and standardisation** where global and local experts from all countries developed the regional training programmemes including training of trainers (ToTs). Regional and global health cross cutting priorities like gender and infectious diseases management, biosafety and biosecurity were also integrated.
- **Implementation** at the country level focuses on adapting centrally developed materials to the country context and conducting the agreed-upon capacity development activities. Training and other experiential learning activities were conducted. The country initiated some initiatives, such as One Health Leadership in the Democratic Republic of Congo. At the regional level, regional initiatives Implementation also
- **Scale-up:** the initiatives and training modules, tools, and materials implemented in one country formed the basis for the development of similar efforts in another country. Countries customised them to their local situations while maintaining the set regional standards.

The in-service training model evolved over two USAID-funded projects: June 2012 - June 2014 (Strengthening and expansion of One Health Central and Eastern Africa Network) and January 2015 - November 2019 (One Health workforce) (16).

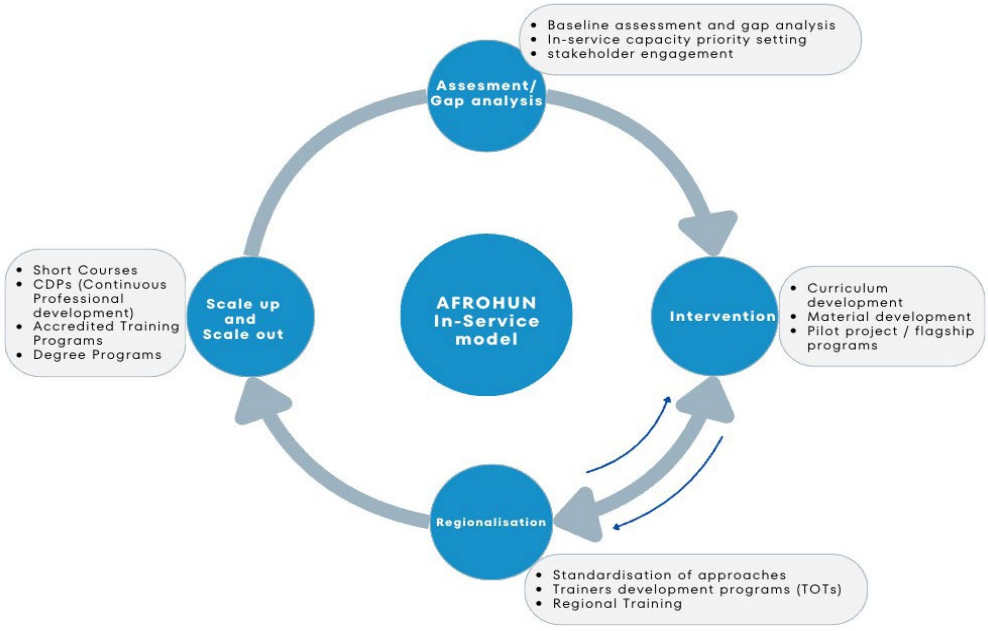

Figure 4.1: The AFROHUN In-service Capacity Building model

The key in-service priorities with impacts on national health systems across the region were identified from the country assessments and gap analysis conducted in each of the countries between 2017 and 2019 to identify priority capacity needs (3,17–19). The priorities included: (1) Risk analysis (risk assessment, risk communication and risk management) was a priority in Ethiopia and Kenya; (2) One Health Leadership was a priority in DRC, Uganda, and Kenya), (3) Antimicrobial Resistance/AMR in Cameroon and Rwanda, (4) Bio-Risk Management (BRM) was a regional trainers' development programme that benefited for all countries, (5) Cross-sectoral coordination and collaboration was a priority in Tanzania. Cross-cutting topics, including One Health principles and concepts, Gender and infectious disease management, and systems thinking, were integrated into all training. The topics are in alignment with the One Health competence domains (15).

Gender and Social Inclusion (GEDSI) was another cross-cutting priority. AFROHUN promotes an active and visible policy of mainstreaming a gender perspective, which includes disability and social inclusion dimensions, in all training programmemes. AFROHUN is employing a three-pronged gender, disability and social inclusion (GEDSI) integration strategy to guide effective gender mainstreaming and inclusivity as follows: (i) building capacity in gender and social analysis and integration, (ii) engendering the processes, methodologies and structures of programmemes including in-service training; (iii) generating evidence-based GEDSI-responsive targeted initiatives for more impactful outcomes. AFROHUN has

a gender policy, strategy, roadmap and tools that support the GEDSI mainstreaming work.

Case studies on selected high-impact in-service initiatives from different AFROHUN countries are presented, demonstrating processes used, lessons learned, the role played, and impacts made by AFROHUN in improving national public health systems at the individual, institutional and system-wide levels as demonstrated in this chapter.

Impact case studies of in-service capacity-building efforts

In this section, we showcase selected high-impact in-service capacity building programmemes across the region that governments have praised for delivering competent in-service professionals around core technical One Health competencies and soft skills. The specific cases include One Health Leadership, Antimicrobial Resistance (AMR), and Bio-risk Management (BRM).

Impact case 1. Building a regional pool of Bio-risk management (BRM) experts for East Africa and beyond

Needs Assessment and Context Analysis

A residential area deep in the municipalities (communes) of Kamalondo and Lubumbashi in the Democratic Republic of Congo is an example of many places in Africa ideal for managing bio-risks. In this area, waste management practices are poor, and sewage systems are inadequate to handle the waste. In some instances, animals are slaughtered in makeshift slaughterhouses, with blood and other water poured directly into the open sewage systems. In case animals like goats for slaughter tested positive for ***Brucellosis,*** the risk of human infection is high. First, the people who handle the slaughter typically have no personal protective equipment (PPE). Second, since waste from the slaughtered goats is emptied into the open sewerage system, the Brucella bacteria survive in the sewers. Third, it is not uncommon for effluent from such sewerage systems to find its way into water sources.

Between 2013 and 2014, in Kalamondo, a high number of febrile cases were observed. Soon, pharmacies were bombarded with cases of patients complaining of high fever. Since malaria is endemic in the area, most patients were given anti-malarial drugs but did not get better. The lack of knowledge and holistic medical practice in managing such zoonotic diseases often leads to the spread of Brucellosis disease.

This scenario in Lubumbashi is not an isolated case. Many communities in Africa show the Lubumbashi problem. Such a situation presents a complex health challenge that requires a One Health approach.

Rationale and intervention design

The scenario of inadequate bio-risk management capacity described above is one that AFROHUN set out to support as part of its in-service capacity building efforts. Managing bio-risks requires adequate knowledge, skills, and biosafety and biosecurity measures in institutions. Between 2014 and 2015, AFROHUN, in partnership with Sandia National

Laboratories[1] and the International Biological and Chemical Threat Reduction (SNL/IBCTR) Group, set out to establish a sustainable BRM capacity building mechanism for East Africa. This approach is built on SNL's 5-year experience strengthening biosafety and biosecurity systems in the East African region (mainly in Uganda and Kenya) (20). Through this partnership, a regional BRM capacity building mechanism for EA and beyond was developed leveraging AFROHUN as a regional capacity building platform for universities which are training institutions. As part of this partnership, AFROHUN and its member universities worked together with bioscience institutes such as Uganda Virus Research Institute (UVRI), blending their strengths to create a regional pool of competent BRM trainers to support continuous capacity building in the region.

How did the SNL / AFROHUN partnership evolve?

The SNL/IBCTR, with support from the Defence Threat Reduction Agency of the US government (DTRA), has been training and supporting bioscience institutes in Kenya and Uganda for over five years, supporting institutes to put in place biosafety and biosecurity systems and building human capacities within bioscience institutions (20). With a vision 'to have a sustainable capacity building mechanism for East Africa', SNL searched and identified AFROHUN as an ideal regional institution with a training mandate as an ideal organisation for anchoring a BRM capacity building programmeme where a pool of competent local Bio-Risk Management trainers that would support continuous BRM capacity building in African institutions. The roles of the two entities were delineated. The SNL, with its long specialist and technical expertise in bio-risk and biosafety, provided master trainers and granted access to a globally recognised BRM curriculum and resources for the training programmeme. AFROHUN, on the other hand, provided a regional platform as a sustainable mechanism for building a pool of regional BRM experts. The universities and bioscience institutes provided scientists ready to undergo the BRM training as the expert pool and to cascade training and bio-risk practices in their institutions. It is these value adding partnerships that deliver high impact in-service capacity building programmemes.

Using the globally recognised BRM curriculum, the online Global Bio risk management Curriculum (GBRMCNet) https://gcbs.sandia.gov/tools/gbrmc/, a two-phased capacity building programmeme was developed: (1) An Introduction to BRM (2) A Trainer Development Programmeme (TDP) (20). The GBRMCNet resource is technically relevant, consistent, and a credible resource addressing existing and emerging BRM training needs around the world.

Implementation and results

a) Implementation experiences

The Defense Threat Reduction Agency's Cooperative Biological Engagement Programmeme (DTRA CBEP) tasked the SNL/IBCTR to implement a Regional Bio Risk Management (BRM) Programmeme with two complementary activities:

1 Sandia National Laboratories has a 70-year history and is a wholly-owned subsidiary of Honeywell International, Inc. It supports numerous US federal states, local government agencies, companies, and organisations, and investigates bio threats as a global concern.

1) The introduction to the BRM training course targeted both leaders and biosafety officers within the institutes and faculty from science disciplines in AFROHUN member institutions that train bioscience professionals who end up in bioscience institutes. Participants were carefully selected, targeting management and leaders, veterinarians and laboratory professionals in bioscience institutes, biosafety or bio-security officers, and BRM trainers (university professors and lecturers). These were seen as key people engaged in developing organisational safety and security culture.

   Between 2014 and 2015, a total of 1538 participants from Eastern Africa (Kenya, Uganda, DRC, Ethiopia, Tanzania) completed the introduction to BRM training (20).

2) BRM Trainer Development Programmeme (TDP). From the pool of trainees that underwent the introduction to the BRM course, those with a training responsibility or opportunities for building human capacity within their institutes/ universities were open to joining the TDP. This was voluntary and targeted those willing to take up the responsibility of being regional BRM experts. A total of 37 were trained as the regional BRM pool of experts (20). They were trained and mentored by international BRM experts and acquired both the BRM technical competencies and pedagogical skills and training knowledge to enable them to train others. They were also given access to SNL resource materials on the online Global Bio Risk Management Curriculum (GBRMCNet) https://gcbs.sandia.gov/tools/gbrmc/, which was adopted as a standard for in-service training across the region. They used this resource for education and training on bio-risk management in their institutions and universities, thus leading to the desire for institutionalisation and continuous BRM capacity strengthening.

A group of trainees from Ethiopia, Uganda and Kenya participating in a group activity during the Introduction to BRM Training in Kampala, Uganda in 2015. Between 2014 and 2015, a total of 1538 leaders and biosafety officers, underwent the training. Source: AFROHUN Secretariat archives.

An image showing Stick-It notes on a flip chart, from a group exercise at the Kampala 2015 BRM Training for leaders and biosafety officers. The BRM trainings were highly participatory and involving for the trainees. Source: AFROHUN Secretariat archives.

b) Feedback and survey results

According to a Sandia survey (20), three years after the project, most participants highly rated the training. It was found that:

- 57.3% of trainees reported that they had conducted BRM training courses either on their own or with a co-trainer in the previous year (after the SNL/AFROHUN training).
- 47% suggested that many BRM trainees recognised the value of their BRM training and were motivated to provide input and feedback regarding their current BRM practices and future BRM training needs.
- Over 90% of the survey respondents were from Kenya and Uganda, reflecting the fact that these two countries in East Africa had been engaged for the longest period by DTRA/CBEP and SNL. Both Kenya and Uganda currently have biosafety and biosecurity bills moving through their respective parliament committees.

Other training outcomes include adapting and scaling up BRM training in university teaching by BRM trainers.

Prof. Ngona Idi, a professor and lecturer at the University of Lubumbashi (UNILU) in DRC, was one of the 37 BRM trainers who took on the knowledge gained and improved his course. A former AFROHUN Focal Person, Prof. Ngona, had observed the lack of good BRM practices within his community in the makeshift slaughter places, markets, and the people living around these places. Taking advantage of the Theriogenology course he taught at the University of Lubumbashi (UNILU), he inserted concepts and topics of BRM and One Health competencies in a university course from 2015 that benefited 710 students.

He had this to say, *"I chose the ambulatory clinic practice, when students undergo field work and using what I had learnt, I helped students to practically appreciate bio-risk, BRM and the possibility of exposure to pathogens (Biosecurity) and how PPE (Personal Protective Equipment) helps to mitigate any contamination (Biosafety)"*.

The use of PPEs during the practical training sessions is a best practice in biosecurity, and university faculty and students became aware of this requirement because of the BRM training. Since the integration of this topic and following engagements with the University of Lubumbashi, a budget was provided for some PPEs (gloves, soap, and antiseptic). In contrast, students provided such PPEs as aprons and boots. Integration of this important topic and institutionalisation of its financing enabled the recent graduates to gain this critical knowledge that past graduates were not able to gain, and this contribution is attributable partially to AFROHUN as well as the Professor who was proactive in the application of the knowledge gained.

Similarly, Dr. Wilfred Emonyi Injera from Moi University, Kenya, another beneficiary of the BRM trainer development course, also integrated and delivered BRM topics in the Field Epidemiology and Laboratory Training programmeme (FELTP). This was a programmeme that sought to build capacity in health agencies, for example, targeting ministries of health or national public health institutes, by training the public health workforce in field epidemiology

and other public health competencies, including bio safety and bio-security, which meant that this workforce, going through this highly demanded course would continuously deliver biosecurity and bio-safety conscious personnel and a more strategic and sustainable approach.

Scaling up and sustaining BRM training in AFROHUN countries

Scale up experiences

Following the regional BRM capacity building programmeme, several countries replicated the training in-country, creating a multiplier effect of this regional-to-country in-service development model yielding significant impacts on the continent.

- For example, Cameroon trained workforce from sectoral ministries (Ministry of Environment, M of Health, M of Livestock), hospitals, National Public Health Lab, Veterinary National Lab, and Private laboratories.
- In Ethiopia: Following the training on Bio-risk Management held in Kampala during the second international One Health conference, professionals sought other training opportunities to improve their knowledge and skill in bio-risk management. Some professionals were able to take the 2018 training hosted by the Kenya Biosafety and Biosecurity Association and the International Biosafety and Biosecurity Association based in Canada. Overall, 230 professionals were trained to use biosafety, biosecurity and bio-risk management in their work when tackling public health emergencies.

The fruits of this training have extended to recent epidemics and have supported ongoing efforts to consolidate the BRM agenda.

- **COVID-19 Response:** The AFROHUN Secretariat played a vital role in Risk Communication and Community Engagement (RCCE) during the COVID-19 pandemic. From 2020 to 2022, AFROHUN-Cameroon collaborated with the government and partners to develop and evaluate RCCE curricula. Similarly, AFROHUN-Côte d'Ivoire partnered with the ARPA Fund and other stakeholders to support COVID-19 response efforts.
- **Strategic Partnerships:** Building on the momentum from the initial training programmemes, AFROHUN continued to seek partnerships with governments, public and private sectors, civil society, and academia to strengthen BRM capabilities across Africa.
- **Legislative Progress:** Both Kenya and Uganda have made significant strides in advancing biosafety and biosecurity legislation, reflecting the positive impact of the training programmemes and ongoing advocacy efforts.

Lessons from the BRM intervention

- The catalytic role of universities (while for five years SNL had made significant progress at the individual bioscience institutions in strengthening their biosecurity systems, the in-service professionals appreciated the joint trainer development capacity building they underwent together with the university professors and lecturers. Trainees also

valued the opportunity to gain experience from international experts, which facilitated the application of BRM knowledge in their institutions.

- Standardisation and maintaining the quality of materials, e.g. through access to high quality and technically relevant, consistent, and credible resource materials and concise handbook on different BRM topics, stimulated and enhanced BRM knowledge and easily facilitated the application of knowledge gained back in participants' institutions. However, the BRM training programmeme's adaptability to different contexts and its alignment with global standards made it a valuable resource for addressing bio-risk challenges in diverse African communities.
- The institutionalisation process and scale-up of in-service training programmemes enabled through AFROHUN as a regional platform and through her member institutions was found to be an efficient and cost-effective mechanism by international partners like SNL. The careful selection of participants, blending academic and practical expertise, enhanced the training's effectiveness and demonstrated the benefits of diverse perspectives. Similarly, the creation of a regional pool of BRM trainers and experts has ensured the programmeme's sustained lasting impact, allowing for continuous knowledge transfer and capacity building within institutions and communities.
- Impactful in-service training is where a partnership of diverse actors builds off their unique and complementary roles and experience, thereby leading to unique competencies (attitudes, skills and knowledge) among in-service professionals. A combination of international and local (south to south) partnerships has been found to be very rich. By leveraging diverse expertise, the programmeme successfully established a foundation for continued BRM development across the region.

Impact case 2. A case of DRC Territory Administrators One Health Leadership in-service training

Needs Assessment and Context Analysis

a) Context and rationale

One Health leadership was among the high in-service priority capacity needs during the needs assessment and gap analysis in most countries. In many AFROHUN countries, including DRC, Kenya, Uganda, and Ethiopia, it emerged as a priority area during the gap analysis (3,18). One Health Leadership is one of the One Health competency domains needed to provide effective leadership for the management of public health emergencies and other complex health challenges. According to Amuguni et al. (12), examples of competencies under the One Health Leadership domain include the ability to promote mutual respect between different professions, to develop an integrative vision and strategic thinking, the ability to motivate, delegate, and resource mobilise, ability to demonstrate decisiveness and effective teamwork in One Health situations.

In the 21st century, a public health professional in Africa needs to be versatile and competent to manage complex challenges as they emerge (4). Challenges of the

time, among them recurring pandemics, conflicts, natural disasters, population growth, extreme poverty, food insecurity, climate change, and biodiversity loss, require a dynamic, competent professional. Preventing and managing public health emergencies using a more effective multisectoral approach necessitates sustained commitment and a range of broader approaches and soft skills, with one health leadership being one of them. The COVID-19 pandemic demonstrated how leadership can deliver or derail effective response efforts (21,22).

b) A spotlight on DRC's government systems

DRC is a hotspot for zoonotic diseases that interplay with other challenges, creating a web of complexities that require a One Health approach. The country is big, with 26 provinces. Each province is subdivided into four different entities: territory, sector or chiefdom, village agglomeration, and villages. In total, there are 145 territory administrators assisted by 290 deputies. Cities, which are divided into communes, are autonomous and are run by a mayor. Each entity plays a key administrative, technical, economic, and political prerogative and is led by a Territory Administrator (TA) who provides leadership and oversight for the implementation of the government vision. The TAs oversee all sectors of territory development and are responsible for the health, security, and well-being of communities (23).

TAs normally have a background or specific training in public administration, and given their broad responsibilities, strengthening their capacity to deliver to their wider mandate is at the heart of the Ministry of Interior's capacity-strengthening plan. Continuous professional development is one of the priorities set out in the roadmap of the General Inspectorate of Territorial Agents (Inspection Générale de la Territoriale). Indeed, One Health Leadership training was a top priority during the needs assessment and gap analysis that preceded all in-service capacity building. The training of managers and key multisectoral actors in One Health Leadership becomes a model of interest to leaders, enabling them to acquire the necessary skills to prepare for, prevent, and effectively manage public health emergencies.

Intervention Design: Participatory approach and co-creation of the Territory Administrators' One Health Leadership training programme.

In 2016, AFROHUN supported experts from key disciplines to co-create a training on One Health Leadership in early detection and response to health emergencies in DRC. Leadership is key in infectious disease management. Training Territory Administrators along with their technical teams, including district health officers, animal health officers, hygiene and environmental officers, and civil society representatives, was deemed important to strengthen leadership and collaboration in the management of health emergencies. Despite their key role in health emergencies, management of epidemics was previously seen by TAs as a medical professional's work. The training was intended to demonstrate the responsibility of Territory Administrators as heads of the territorial entities and to give them the competencies needed to play that role. It was also meant to reaffirm their leadership in working with the technical teams.

a) Training development processes

It all started with ensuring that the right training programmeme was developed to meet real needs and was appropriate for the specific local government levels. A One Health Leadership training module was developed through a participatory process involving faculty from the University of Kinshasa School of Public Health, the School of Veterinary Medicine, the School of Social Sciences (anthropology), the Ministry of Health (Programmeme National des Urgences Humanitaires), and the Inspection Nationale de la Territorial through six workshops. The Ministry of Interior was involved from the beginning, not as consumers of the training but as owners, designers, and facilitators. Their active involvement was valuable in capturing and adequately responding to capacity issues and targeting the right participants.

b) Insights from participants in the training development process

Dr. Thierry Mukalakata, one of the faculty leaders from the School of Veterinary Medicine, University of Kinshasa, had this to say,

"This helped with understanding the new configuration of territories and provinces that had just been created at the time".

Mr. Didier Mulolo from the Inspection de la Territoriale, Ministry of the Interior, acknowledged that working with diverse team members was an enriching experience for him.

"There were engaging discussions to determine the content, and we agreed on concepts and what they meant since people came from different backgrounds. This made the module more relevant. This was the price we had to pay. We had to be able to work in a team to train others to work in teams".

Implementation and results

a) Training delivery and curriculum

Over the decade and across countries, the TA One Health leadership capacity building took on different forms with varying impacts on countries. For some countries like DRC, it was fully embraced by the government. It has been documented with significant positive success in the Ministry of Interior and the country, as demonstrated in the testimonies below. Similar contributions have been made to Kenya's Siaya County.

One Health Leadership training intervention in DRC was delivered in a series of five-day in-person training sessions, as indicated in the table below.

Table 4.1: Overview of five-day training

Day	Module content
Day 1	Exposure to the leadership module with group work discussing real-life case studies. Participants' reflections on their day-to-day leadership responsibilities in health emergencies.
Day 2	Discussions on the roles and responsibilities of Territory Administrators as provided by the law. Note. The sessions were facilitated by the Territory Administrator Inspectorate using their lived experiences.
Day 3-4:	Focus on risk analysis in groups, identify health emergency risks in communities, and develop a contingency plan focusing on the risks prioritised within the context of each territory. Other topics of focus – One health approach for preparedness and response to health emergencies, reflections by MoH experts on how to effectively increase coordination and information sharing during the response to emergencies such as Ebola, avian flu, and volcanic eruption.
Day 5:	Risk communication and community engagement. A field visit to the local market and abattoir for a practical experience to understand the risks of zoonotic disease transmission. Post-training follow-up and evaluations.

The Territory Administrators' Training in One Health Leadership in DRC is a flagship programmeme that has been running for close to ten years. In these photos, (Top) a group of territory administrators from various territories work together in a group exercise during their training in 2016. Source: AFROHUN DRC archives.

Another cohort of Territory Administrators training in 2022 celebrate after graduating. Here (Top), a female Territory Administrator proudly displays her certificate to colleagues, and (Bottom) a after a refresher training in 2021 that integrated RCCE which was not part of the initial training. Here they are engaging community members on COVID-19 prevention and control. Source: AFROHUN DRC archives.

b) Impacts to trainees

- **Appreciation of the knowledge by trainees:** Mr Charles Iloankoy Kake N'Songe, Territory Administrator of Tshela in Kongo-Central, had this to say:

  "the skills acquired during the training are very helpful for our work. Good planning, risk identification, and contingency plan development are key to avoiding improvisation when epidemics or natural disasters come. As the leader of the territory, I will coordinate everything in an organised manner. We now know everyone's role and the points of the intervention."

- **Empowerment:** Territory Administrators were empowered to do things they had never imagined doing. Mr. Lelo Alupambu Fidel Feshi, Territory Administrator, Kwango province, said

  "The One Health Approach has allowed us to develop prevention initiatives and identify local skills while involving our communities to effectively manage public health emergencies at the human-animal and environmental interface. We are equipped and able to elaborate the contingency plans of our territorial entities. I hope that this training will also be provided to other executives of our administration, including governors and provincial and national ministers."

- **Risk mapping and contingency plans:** Territory Administrators mapped the risks for their areas and developed contingency plans. Multi-risk and specific contingency plans were developed with the participation of various departments and sectors. Territory Administrators were equipped to manage health emergencies using a multidisciplinary One Health approach. This was demonstrated during the Ebola outbreak and the COVID-19 pandemic. The territories and sectors that participated in the training performed better. Mr. Mulolo pointed this out as a key area of delivery attributed to the training.

- **Training reach:** Throughout implementing the training, there were significant outcomes and results. A significant percentage of 14% of the Territory Administrators in DRC (60 out of 435) were trained through this training support over the five years. These were from 25 territories (in the provinces of Kongo Central, Kwango, and Equateur) out of the 145 territories in the country. In addition to this metric, the interior ministry took on the module and integrated it into the National School of Administration curriculum, which will reach more trainees throughout the country.

- **Improved performance:** Leadership of the DRC Ministry of Interior reported improved performance among Territorial Administrators after the training compared to how they performed the same duties before the training. Mostly reported was a *'high understanding of the issues of prevention, response, and management of health emergencies; the development and implementation of the contingency plans; a high sense of responsibility and leadership'*.

- **Success story – Dr. Cecil Kutenalu** Dr. Cecil Kutenalu was one of those trained. A few years later, she was part of a team from the Ministry of Health leading the National Ebola response, utilising the knowledge she had gained during the training, which came in handy in identifying gaps in the response structure. The training also equipped her with knowledge of how to manage teams and partners.

- **Enhanced reporting parameters:** Following this training, reporting parameters by the Territory Administrators were broadened to include more data, including that related to One Health issues. For instance, there was the integration of data relating to risk mapping and improvement of the functioning of territorial committees for the management of natural disasters, epidemics, and epizootics, among other areas of improvement.
- **COVID-19 pandemic management:** In 2020, when the COVID-19 pandemic occurred, the administrators and their technical staff were able to use their contingency plans to manage the pandemic. The training enabled them to effectively play their role as leaders in coordination during the COVID-19 prevention, response, and recovery phases.

c) Impacts on training facilitators

The facilitators of the One Health Leadership training also experienced professional growth and development, gaining insights and competencies that extended beyond the training objectives.

- **Innovative Curriculum Development:** Prof. Prince Diangs Kimpanga from the University of Kinshasa highlighted the innovative nature of the curriculum development process. Unlike traditional university approaches, this process involved defining trainee profiles and identifying competency gaps, resulting in a more targeted and effective training programmeme. He remarked:

  "This was an enriching experience for the facilitators, especially for those of us from the universities. We usually do curriculum development in our offices. This process was different. We started by describing the profile of the people to be trained, and then we identified the missing competencies. This is different from how we do it here at the university."

- **Interdisciplinary Exposure:**

  Dr. Thierry Mukalakata, a veterinarian, noted the enriching professional exchanges facilitated by the training. By collaborating with participants from diverse disciplines, facilitators gained valuable insights into territory administration and were exposed to various professional experiences. This interdisciplinary interaction fostered a deeper understanding of multisectoral challenges and solutions. Dr. Mukalakata, observed:

  "As a veterinary doctor working with the Ministry of Interior, the training enabled me to learn a lot, especially how territories are administered. The professional exchanges were enriching. Working with participants from many disciplines exposed us to varied experiences. The first ones to be trained went back and shared with their colleagues what they had learnt, creating more demand for the training."

- **Creation of Training Demand**

  As facilitators engaged with participants from various backgrounds, they observed a ripple effect of knowledge dissemination. Early trainees shared their learnings with colleagues, generating increased demand for the training and highlighting its perceived value and impact.

National Scale-Up and Regionalization

The One Health Leadership training programmeme's success in the DRC has paved the way for its expansion and adaptation in other regions. The programmeme, initially targeting Territory Administrators to enhance their leadership skills for managing public health emergencies, has been effectively scaled up and regionalised, demonstrating significant impacts beyond its original scope. Two pathways to change are detailed below:

First, the institutionalisation at the National Level: In 2022, the One Health Leadership training module was updated to incorporate lessons from COVID-19 management, including gender considerations and risk communication for community engagement. This revised module was integrated into the National School of Administration (NSA) curriculum in the DRC, a government training facility for public administrators. AFROHUN's training of NSA teachers as trainers ensures the programmeme's sustainability and broader reach, allowing for consistent delivery across more provinces than the original project scope.

Second, expansion to Other Countries: The training module developed for DRC's Territory Administrators has been adapted as a template for similar programmemes in other countries, such as Cameroon and Uganda. Uganda, in particular, is integrating the One Health approach into its decentralisation strategy, showcasing the programmeme's adaptability and regional influence. This template serves as a foundation for countries looking to bolster their public health leadership and preparedness frameworks.

Lessons and Challenges:

1) **Needs-based participatory design and implementation deliver high impact programmemes.** In this scenario, the training was adopted through a systematic process of needs assessment and intervention developed through a participatory multistakeholder approach, which enhanced its relevance and responsiveness to national priorities and local needs.

2) **Value-adding partnerships.** The diversity of partners involved in developing the training programmeme brought together experts with different professional backgrounds, leading to the development of training that addressed multifaceted real-life capacity issues. The key partners included academia from different disciplines, policymakers in the Ministry of Interior and practitioners, all contributing to a comprehensive and impactful training experience.

3) **Innovative and multidisciplinary approach:** Involvement of national and sub-national leadership and multidisciplinary teams is key in infectious disease management and response. In this regard, training of Territory Administrators along with technical teams from human health, animal health, hygiene and environment, and civil society representatives strengthens effective and coordinated efforts that go beyond a single or few training events. For instance, multisectoral interactions during the training enabled informed action and appreciation of the holistic nature of epidemic response. This further emphasises the need to promote multidisciplinary approaches that AFROHUN champions.

4) **Government engagement:** Engaging government ministries, departments, and agencies (MDAs) from the planning stage proved to be a strong strategy for ensuring relevance, ownership, and sustainability. The active involvement of the Ministry of the Interior as owners, designers, and facilitators contributed significantly to the programmeme's success and long-term impact.

5) **The institutionalisation of training initiatives is critical for their success and sustainability.** This was noted when the trained Territory Administrators and their technical staff were frequently transferred from one duty station to another as per public service norms. This affected the sustainability of initiatives started by the transferred officers. This was, however, mitigated with the NSA taking over the training, which effectively created ownership by the Government through the NSA. Therefore, all Territory Administrators were able to attend the training before they were deployed for duty.

Impact case 3. A need-driven Antimicrobial Resistance (AMR) training: AFROHUN Cameroon pioneers AMR in-service training.

Needs Assessment and Contextual Analysis

Antimicrobial resistance (AMR) poses a global threat to public and environmental health. In May 2015, during the 68th World Health Assembly, the global action plan (MAP) to fight against AMR was adopted, with one of its objectives to improve awareness and understanding of antimicrobial resistance through effective communication, education and training (24,25). It was further recommended that each country develop a national action plan (NAP) to fight against AMR (26). All ten AFROHUN countries have NAPs.

In Cameroon, a systematic review and meta-analysis estimates AMR rates at 68.2% in human health, 13.6% in animal health and 18.2% in the environment (27). Responding to this global public health threat, AFROHUN Cameroon prioritised capacity building, focusing primarily on health professionals (human and animal) and using One Health, a highly participatory and need-driven approach.

Intervention Design

Towards in-service intervention responsive to local needs. In 2017, at Douala, Cameroon, stakeholders from different sectors convened and discussed the magnitude and determinants of the AMR challenge in the country (28). A major recommendation from the consultative process was to conduct a situational analysis using KAP (Knowledge, Attitude and Practice (KAP) targeting human health professionals, animal health actors, agronomists, and environmental health professionals and decision markers. The survey revealed poor perception and practice regarding AMR despite high levels of awareness of the problem across the sectors. It identified gaps and specific training needs in antimicrobial resistance stewardship that AFROHUN Cameroon has since been contributing to. One of the recommendations of this situation analysis was the need to have a training programmeme in AMR.

With different government actors at the centre of shaping every step of the capacity building efforts, AFROHUN Cameroon developed the capacity building programmeme for AMR stewardship in 2018 (28). This was a highly participatory process involving stakeholders from different sectors: Health, Livestock, Agriculture, Environment, and Wildlife), universities, non-academic research institutions, national and international partners (WHO, FAO, IFRC, METABIOTA) and international partners (the University of Minnesota and Tufts University) (29). The in-service training programmeme, a six-month short course, was developed and pilot-tested in 2018. The short course is organised into two parts: three in-person workshops and two field practicums. The course curriculum is organised into 12 modules categorised under three topics: (i) One Health concepts, AMR stewardship and Laboratory and surveillance; (ii) Risk Communication and Community Engagement; and (iii) Quality Control, AMR-regulations.

Implementation arrangements, experiences and results

The six-month pilot short course was run in 2018 through three in-person workshops and two field practicums involving 20 in-service professionals (5 of whom were sponsored by the Livestock Ministry). These were from eight regions and five agro ecological zones in Cameroon, including 4 medical doctors, 4 laboratory scientists, 4 nurses, 1 midwife, 2 pharmacists, 2 veterinary doctors, 1 veterinary nurse, and 1 environmental scientist. Other activity results and outcomes include the following:

- **Training of Rural Women:** 26 rural women club and association leaders were trained on antimicrobial use and AMR. This training emphasised a theoretical-practical relationship, leading to a keen interest in further leadership and AMR training.
- **Sensitisation of Livestock Staff and Farmers:** 30 livestock health staff and farmers were sensitised about AMR risks and the rational use of antimicrobials, leading to changes in workplace attitudes. Evaluations showed improved knowledge and attitudes towards AMR prevention and control.
- **Training and Sensitization Initiatives:**
  - Twenty-five women association leaders improved their understanding of AMR, committing to avoid self-medication and promoting appropriate medication use.
  - Thirty animal and human health professionals were trained in antimicrobial prescription.
  - Twenty-five poultry farmers were sensitised to antimicrobial use in livestock.
  - A television programmeme raised AMR awareness among the local population.

The training clarified the roles of veterinarians and farmers in animal health care, facilitating exchanges that improved contextual understanding and service delivery. The involvement of breeders across various livestock species broadened supply chain understanding.

Trainees and facilitators on the Cameroon Antimicrobial Resistance short course pose for a group photo proudly displaying their certificates, after a graduation ceremony in 2018. The AMR capacity building programmeme in Cameroon has become a major area of focus for the network with a MSc. programmeme now in implementation. Source: AFROHUN Cameroon archives.

A photo showing the front covers of the 'In-service Training Manual on Antimicrobial Resistance (AMR) Stewardship for Human, Animal and Environmental Health Professionals in Africa' Facilitator Guide and Student Guide. Source: AFROHUN Cameroon archives.

Scale-up, regionalisation, and sustainability

The AMR in-service capacity development efforts in Cameroon have evolved, as elaborated in Figure 4.2 below. The short course was appreciated and highly rated by both the government and trainees for responding to country needs. The short course was later developed into a master's degree programmeme, approved and delivered at the University of Buea since the academic year 2022-2023, with two cohorts of fifteen (15) graduate students involved each year. This graduate programmeme benefits the country and in-service professionals. It is a sustainable approach for AMR workforce development that will continue to promote a research and surveillance system for the country.

In September 2021, encouraged by the keen interest of government and individual beneficiaries during the pilot phase, in collaboration with Management Sciences for Health (MSH) through its Medicines, Technologies, and Pharmaceutical Services (MTaPS) Programmeme, an Infection Prevention and Control (IPC) and Antimicrobial Stewardship (AMS) modules were developed into an online course. In addition, a module on surveillance was developed by the Infectious Diseases Detection and Surveillance (IDDS) project and is available for online training.

In September 2023, the AMR training module was validated and made available on an eLearning platform, ensuring accessibility for online training. This institutionalisation effort was pivotal in sustaining the training's reach across different provinces and ensuring long-term impacts beyond the initial project scope.

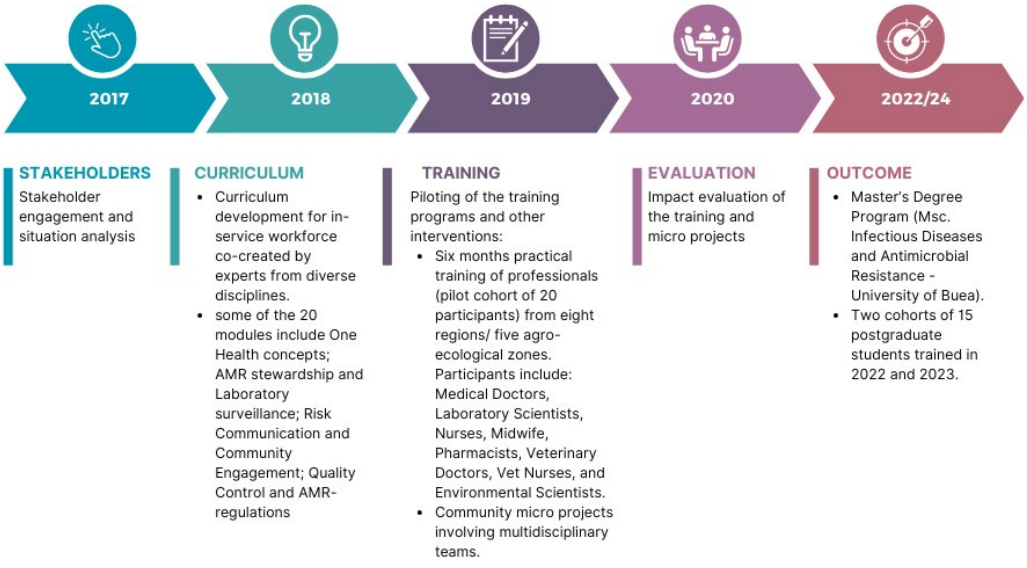

Figure 4.2: The Cameroon AMR Stewardship Trajectory.

Lessons learned from the AMR activity

a) **Key Insights:** The emerging insights from the AMR efforts in Cameroon include the following:

- **Veterinary services accessibility:** Bringing veterinary services closer to pastoralist communities is crucial for AMR prevention. The training highlighted the role of veterinary professionals as key consumers of antimicrobials and their impact on AMR reduction.
- **Continued advocacy:** Ongoing advocacy, particularly in rural areas, is essential for communities to understand the long-term effects of AMR and adopt preventive measures.
- **Government engagement:** Government and stakeholder involvement is vital in shaping effective AMR programmemes and advocating for curriculum integration in veterinary and health schools to lay an early foundation for addressing AMR issues.
- **Networking and collaboration:** In the DRC, AMR training fostered a network between veterinary laboratories, improving collaboration in diagnostics and skill enhancement. Cross-country communication and fellowship among One Health professionals are critical for early identification and concerted responses to public health emergencies.
- **Educational Impact:** Integrating AMR training into university curricula, such as the MSc programmeme at the University of Buea, ensures the sustained education of future professionals in AMR management.

Other broader results and impacts are outlined below

- AFROHUN's in-service capacity-building efforts have influenced One Health policy and practice across host countries, strengthening public health education and service delivery.
- The development of comprehensive training manuals and curricula has extended AFROHUN's reach beyond partner universities and countries, positively impacting public health practices across Africa.
- AFROHUN's engagement with local and international partners has paved the way for sustained improvements in public health education and practice, contributing to a resilient framework to combat AMR effectively and sustainably.

In conclusion, AFROHUN's initiatives underscore the importance of education, accessibility, and collaboration in addressing AMR. By prioritising these elements, AFROHUN is actively contributing to building a resilient framework that effectively addresses AMR challenges, influences policy, and promotes informed approaches among stakeholders.

Critical reflections on overall results and prospects for in-service Capacity Building

Africa faces unique health challenges that require a coordinated and integrated approach to manage and mitigate these issues effectively (1,2). The One Health approach, which emphasises the interconnectedness of human, animal, and environmental health, offers a promising framework for addressing these challenges. The African One Health University Network (AFROHUN) has been at the forefront of capacity-building initiatives aimed at equipping in-service professionals with the skills, knowledge and attitudes necessary to tackle complex health issues in the region. By critically examining three case studies - biosecurity training, One Health leadership, and antimicrobial resistance stewardship, we can gain valuable insights into the successes and challenges of One Health training for in-service professionals in Africa and identify core messages that highlight areas for improvement and future development.

The importance of multidisciplinary training

One of the central tenets of the One Health approach is the need for multidisciplinary training that bridges gaps between various fields such as medicine, veterinary science, environmental science, and public health (14,30). The interconnected nature of these disciplines is fundamental to understanding and managing the health challenges that arise at the interface of human, animal, and environmental health. For instance, biosecurity training programmemes have successfully educated healthcare workers, veterinarians, and environmental scientists about the transmission dynamics of zoonotic diseases and the importance of preventive measures. However, despite these efforts, the training programmemes often fall short of fully integrating these disciplines (31). Professionals continue to work in silos, which limits their ability to collaborate effectively and apply One Health principles in practice. Appreciating this interconnectivity needs to be taught theoretically, but more importantly, it needs to be practically experienced through field experiential learning approaches. Theoretical knowledge, while important, is not enough. There is a pressing need for training programmemes to include practical, hands-on experiences that encourage professionals from diverse fields to work together on real-world health challenges. Such collaborative training not only enhances the understanding of complex health issues but also builds a network of professionals who are prepared to address these challenges collectively (4).

AFROHUN facilitated the development of a Risk Communication and Community Engagement (RCCE) curriculum (a flagship under the One Health Academy in Chapter 5), among other modules, for all partner countries. These courses have proved relevant to building competencies to manage complex public health threats, the likes of the COVID-19 pandemic (6). The training and capacity building of in-service professionals has improved the level of communication between One Health professionals in-country and across countries. This improved communication and fellowship between One Health professionals is critical in ensuring that public health emergencies are flagged early and dealt with in a concerted manner in-country and across countries.

Adapting training to local contexts

Another critical aspect of the in-service training under AFROHUN is the adaptation of programmemes to the specific needs and contexts of different countries and regions. Africa is incredibly diverse, with varying ecosystems, cultural practices, policy environments, and health challenges (4,32). Training programmemes must be tailored to these regional differences to be truly effective. The One Health Leadership training has aimed to cultivate leaders who can advocate for and implement One Health strategies in their respective regions (12). However, there is often a disconnect between the training provided and the unique challenges faced by these leaders on the ground. For example, the antimicrobial resistance training conducted in areas with prevalent antibiotic misuse may differ significantly from the training needed in regions where interactions between wildlife and livestock are more critical. Regional efforts such as bio-security training, were further adapted to the country's specific contexts.

Similarly, trainings initiated in one country were adapted when scaled up to other contexts. In-service training requires a good understanding of the government systems and public service arrangements in which the participants operate (9). The One Health Leadership Training in Congo focused on the Territorial Administrators, who are critical cadres in the local governance for health. One Health training should be aligned with local systems, empowering professionals to implement strategies that resonate with local realities. This alignment will ensure they are fit for purpose and context to address local and regional health challenges and priorities effectively.

Engaging local communities and leveraging indigenous knowledge

Engaging local communities and leveraging indigenous knowledge is essential for the success and sustainability of One Health initiatives (33). Local communities often possess valuable insights and practices that can contribute to the One Health approach. Their involvement ensures that health interventions are culturally sensitive, accepted, and sustained over the long term. Their involvement also empowers them with some knowledge of local challenges that trainees work on in the field collaboratively with different stakeholders, thereby leaving them with workable solutions to such challenges. The case study on antimicrobial resistance highlights the potential benefits of community-based strategies and the adoption of systems thinking that comprehensively look into local practices in antibiotic use and livestock management. However, many current training programmemes tend to overlook these aspects (5,34). To truly harness the potential of the One Health approach, professionals must be trained to engage effectively with communities and integrate indigenous knowledge into health interventions (33). This engagement fosters community ownership of health initiatives, leading to more sustainable outcomes. By incorporating community perspectives and indigenous knowledge, One Health training can foster a more inclusive and holistic approach to health that is better suited to the unique contexts of African communities.

Ensuring long-term sustainability

Sustainability is a critical consideration for any One Health initiative, yet it is often an afterthought in capacity-building programmemes. While AFROHUN has developed training manuals on biosecurity, risk communication, antimicrobial resistance, and One Health leadership, among others, the true measure of these programmemes lies in their ability to create lasting change. Professionals must be equipped not only with technical skills but also with the capacity to design and maintain sustainable health initiatives that can adapt to evolving circumstances (4,35). Critical lessons on sustainability from the case studies above include local adaption, strategic partnerships at all levels, training of trainers, integration of courses into existing university programmemes, creating formal training programmemes and advocacy to recruit trainees in public service. Long-term commitment from local governments and international partners is essential to ensure the sustainability of One Health efforts (36). This commitment involves providing continuous support for training programmemes, access to internationally recognised training resources, investing in infrastructure, and fostering a culture of continuous learning and adaptation among professionals. Training programmemes should include components that focus on building resilient health systems and communities capable of withstanding future health challenges (4,22). By prioritising sustainability, One Health training can contribute to the development of a robust framework for managing health threats, ensuring that gains made are not lost over time.

AFROHUN's commitment to sustainable One Health efforts is demonstrated in its membership in different national and regional One Health technical working groups, dissemination of evidence-based information, and contribution to public debates as a means of helping shape the design policies adapted to the local and regional context (6). AFROHUN has contributed to national Joint Internal and External Evaluation Assessments in partner countries, especially in the area of Human Resource Capacities (37–39). AFROHUN has contributed to regional efforts, including Africa CDC's framework for One Health Practice in National Public Health Institutes and AU-IBAR's Animal Health Strategy for Africa. These engagements reinforce the broader efforts to entrench one health approach on the continent.

Promoting cross-sectoral collaboration

Capacity building is not the end of the story. One of the fundamental principles of the One Health Approach is cross-sectoral collaboration. In-service professionals in Africa often work in silos, with limited interaction between healthcare workers, veterinarians, and environmental scientists (40,41). Capacity-building programmemes should aim to break down these barriers and promote interdisciplinary collaboration. These professionals need to understand the interdependence of their respective fields and the role they play in mitigating health risks (42). Sustained efforts to encourage professionals to collaborate internationally to address global health challenges are essential. Many health threats cross borders, so sharing knowledge and expertise with colleagues from other countries is crucial.

Building a competent, holistic, and dynamic professional ready for today's complex challenges

without a conducive policy and practice environment to apply the knowledge gained is a frustration to many. In the last five years, AFROHUN has increased its interaction with national and sub-national governments, regional bodies, and international One Health players to advance One Health goals and enhance the One Health policy environment in the region (8,9). AFROHUN has played a significant role in each host country, providing capacity building on One Health for in-service professionals. This has improved the provision of public health services, as well as the response and management of public health emergencies.

AFROHUN's advocacy around in-service capacity building in One Health has played a big contribution in transforming the mindset of One Health professionals from a silo-based approach in which each discipline works on its own to a One Health-based approach in which all disciplines collaborate. Deliberate government engagement and collaboration with local and international partners while strengthening human resource capacity is key to paving the way for sustained improvements in collaborative health education and practice. As AFROHUN continues to address global threats, the integration of comprehensive training programmemes and the assurance of collaborative networks are critical. By prioritising education, accessibility, and collaboration, AFROHUN is actively contributing to creating a resilient framework to combat complex challenges like AMR and BRM effectively and sustainably, including policy influence for the relevant stakeholders to adopt more informed approaches.

Conclusion

AFROHUN will continue to play a significant and catalysing role in the capacity building of in-service professionals in Africa. It will also bring together these professionals to fellowship beyond their disciplines and develop a multidisciplinary, cross-boundary approach to responding to public health emergencies and pandemics. Retooling in-service professionals and equipping them with the right skills, knowledge, and mindset to appreciate and work across disciplines is a pivotal strategy for strengthening health systems in the current context of emerging and re-emerging public health threats. Impactful in-service capacity building programmemes for upgrading multisectoral capabilities are characterised by active stakeholder involvement where governments are at the centre of shaping training interventions from the start and not just beneficiaries of training activities. Strong partnerships with a mix of south-to-south and north-to-south interested players are key to blending the rich experiences and resources (technical and financial) key to developing appropriate trainings. Finally, leveraging existing networks, especially regional networks like AFROHUN, is an effective way to deliver standardised and regionally relevant interventions.

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CHAPTER 5

Building the AFROHUN One Health collaborative research programmeme

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Introduction

The concept of One Health was coined from the integrated study of zoonoses. It currently encompasses the interconnections between human, animal, and environmental health using a multidisciplinary approach necessitated by a complex biological and social system, which involves multiple actors and processes and their interactions over time at the local, national, and global levels (1,2). Success in public health interventions that address complex health challenges can be achieved through collaboration across the human, animal and environmental health sectors for more rapid, mutually beneficial and effective responses (3). These responses require quality and timely data and information through research and innovation conducted by multidisciplinary teams of researchers who not only have a disciplinary grasp of the problem. Still, they are also empowered with the understanding of the One Health principles. This chapter intends to introduce the concept of One Health research, outline the development of the One Health research initiatives under the Africa One Health University Network (AFROHUN) and envisage the future of One Health research of the network.

Building One Health research capacity in Africa is a crucial initiative. It involves empowering institutions to link research to policy and practice that addresses complex health challenges using a One Health approach (4–6). This not only yields quality One Health research products but also increases recognition among academia, governments, development

partners and the global community of the need to view many societal problems as systems problems requiring interdisciplinary efforts.

AFROHUN recognised the importance of applying a One Health approach to research to develop innovative solutions to the complex and interrelated human, animal, and environmental health challenges faced in the region (7,8). The One Health approach to research would ensure that human, animal, and environmental health questions are evaluated in an integrated and holistic manner to provide a more comprehensive understanding of the problem and potential solutions that would not be possible with siloed approaches (9). The introduction of a One Health research initiative in the network required building the One Health research capacity of network researchers and conducting multidisciplinary research to address identified priority research areas using the One Health approach.

Operationally, AFROHUN defines One Health research in terms of a multidisciplinary approach to understanding and addressing health challenges that recognise the complex interactions and interconnectedness of human, animal and environmental health (10,11). It emphasises collaboration between various scientific disciplines, with each discipline contributing to understanding the problem and providing solutions to the problem for the improvement of the health and well-being of humans, animals and the environment.

Humble beginnings

AFROHUN seized an opportunity to access funding from the leadership of the USAID HED programmeme through Dr. Denis Carrol to initiate research activities within the network under the OHCEA Research Innovation Project (ORIP) in 2014. The research grant worth US Dollars 500,000 was made available to the network to initiate its much-needed One Health research initiative in the region. With the US-based Tulane University School of Public Health and Tropical Medicine, AFROHUN established ORIP as an 18-month collaborative One Health Research initiative in the Eastern and Central Africa region (12). Designing the programmeme, building a research grants management infrastructure, and assembling a solid team of One Health research champions were prioritised as start-up processes.

In 2014, AFROHUN embarked on building a regional research initiative that provides strong evidence for the strategic management of zoonotic diseases in Africa using the One Health Approach. The design embedded strengthening research capability within the AFROHUN network to deliver demand-driven research as decision support tools. The capacity development strategy was initiated through a small research grants programmeme for university students and faculty which was designed through a regional workshop of a multidisciplinary team of senior researchers that developed a regional research agenda and a regional advocacy meeting for women leadership in research. ORIP project activities focused on developing the network's research infrastructure and multidisciplinary team competencies. Under the project, AFROHUN developed (i) a cross-national, interdisciplinary and cross-rank research network of faculty and students; (ii) a regional research grants management infrastructure; (iii) interdisciplinary and community-based research skills among faculty and students in the region; (iv) four cross-national and three national publications; (v) an Eastern and Central regional research agenda and (vi) a research resource mobilisation plan.

AFROHUN recognised that there were many actors researching diseases of One Health relevance. AFROHUN undertook to identify knowledge gaps that academic institutions could address with the dual purpose of promoting research and education that contribute to policy and surveillance systems, strengthening field observations with a focus on disease prevention and response. This would differ from the USAID PREDICT project that focused on viral isolation and characterisation from bats, primates and rodents. During a strategic workshop held in April 2016, participants from 10 African universities and 2 US Universities convened in Nairobi, Kenya, with a dual purpose, namely, to develop a list of strategic research areas and a collaborative plan to increase funding for these research areas (13). Diseases of significant importance to the region, both locally and internationally, were listed and categorised under seven broader themes, as shown in Table 5.1.

Table 5.1 : Change in AFROHUN's priority research areas over time

Priority/ Strategic Research Areas	2014	2016	2023
Infectious disease investigation, prevention, early detection and outbreak response		X	X
Emerging diseases (zoonotic disease, transboundary diseases, early detection), vector-borne diseases	X	X	X
Emerging health challenges (Anti-microbial resistance and use)	X	X	X
Food safety and security, nutrition	X		X
Climate change/ disaster preparedness	X		X
One Healthpolicy	X		
One Healthfinancing	X		
One Healtheducation	X		X
One Healthcollaboration, communication, governance, human resources			X
Occupational health and safety	X		
Endemic diseases and early detection of neglected tropical diseases	X	X	X
Gender and infectious diseases			
Biosecurity, Biosafety	X	X	X
Ecosystem and environmental health		X	X
Gender, equity and One Health			X

Institutional development phase

One Health Research remains AFROHUN's core business in spite of the funding limitations. This is expressed in its strategic documents, emerging right from its mission statement. The 10-year strategic plans of 2011-2021 and the AFROHUN Academy and strategic framework 2019-2024, the One Health research agendas, research-related policies such as the 2019 OHCEA Revised Publication Policy, and programmematic documents formed the basis for the design and implementation of the research programmeme. The10-year strategic plan that guided the strategic direction of AFROHUN and later the 2019-2024 strategic framework of AFROHUN situated research as one of the three core pillars of the network with a goal of strengthening multidisciplinary and innovative research on priority areas and sharing information to advance evidence-based training, knowledge, practice, and policy development.

AFROHUN has created and maintained a database that matches research capacities and resources for the network members. The resources include human resources, laboratories and equipment, research administration and institutional review boards for humans and animals. In 2021, the Research and Ethics pillar, one of the five technical pillars of the AFROHUN Academy, was constituted, with a Technical Working Group responsible for developing a road map that includes a five-year research agenda (10). Details of the Academy are covered in Chapter Six.

Organisation and funding of One Health research

Following the ORIP project, in-country and cross-country competitive grants were first given to the faculty and students in 2020-2021. The amount allocated varied from $ 4,000 to $6,000 depending on the project and the country for the in-country small grants. The cross-country small grants were at a maximum of $ 16,000. USAID mainly funded them. In the year 2023, small grants under The AFROHUN Transition Award Multidisciplinary Action Research [TAMAR] Programmeme and Transition Award Professional Development [TAPROD] were awarded. All the countries in the Network benefitted from these grants. The grants involved multidisciplinary teams of faculty and students from AFROHUN member universities.

To strengthen One Health research in Africa, AFROHUN has provided financial, technical and management support to the network members to engage in One Health research on AFROHUN-defined research priority areas, as indicated in Table 1. A small research grants scheme for One Health research and research training has been running whenever there are funding opportunities. Since 2015, three types of competitive small grants have been offered, namely graduate research scholarships for member university students, early career researchers and teaching faculty; student One Health innovative grants; and faculty fellowships. The grant types are distinguished by purpose. They are intended to support multidisciplinary research teams of member institutions to undertake small-scale research projects, while gaining competencies that build their capacity to potentially design and execute larger One Health research projects which respond to Africa's complex health

challenges. Table 5.2 indicates the beneficiaries of the various grant types. In total, 255 students and 186 faculty from member universities have benefited from the small grants initiative. Most beneficiaries came from DRC and Uganda, while the least number was from Côte d'Ivoire. Most funding was for research scholarships.

Table 5.2: Summary of AFROHUN funding grants across grant types and partner countries

Small Research Grant Types	**Beneficiaries**						
	# of research scholarships/ grants		**Faculty fellowships**		**Student One Health innovation grants**		
	Faculty	**Students**	**Faculty**	**Students**	**Faculty**	**Students**	**Total**
Cameroon	3	6	3	3	18	24	**57**
Côte d'Ivoire	0	0	2	4	0	1	**7**
DRC	5	83	2	3	0	0	**93**
Ethiopia	24	6	1	3	0	0	**34**
Kenya	2	11	3	4	0	0	**20**
Rwanda	7	3	6	2	0	7	**25**
Senegal	0	28	2	7	0	42	**79**
Tanzania	21	0	5	10	0	0	**36**
Uganda	56	2	20	6	8	0	**92**
Total	**118**	**139**	**44**	**42**	**26**	**74**	**443**

Graduate research scholarships/grants

To promote One Health research among graduate students and faculty, OHCEA established a graduate students scholarship initiative to support research in the member institutions under the EPT 2 and One Health Workforce projects in 2016. The small research grant provided was up to US Dollars Five Thousand ($5,000). The grants initiative targeted graduate students and junior teaching and early career research faculty enrolled in graduate programmemes at OHCEA member institutions. The objectives of the initiative were threefold. Firstly, to support One Health-related research, with a bias towards disease detection, prevention, and outbreak response or relevant areas that contributed to global health security; second, to contribute towards beneficiaries' completion of their graduate training at the member partner universities; thirdly, to support students publish and disseminate their research.

The graduate students had to have completed their coursework and were required to research One Health-related topic. These research topics were required to fit within the network-defined research priorities, as shown in Table 1. Multi-disciplinarity was a key criterion for vetting. The grants were competitive as applications were reviewed to ensure that the proposal provided for multi-disciplinarity through teams, gender, and One Health competency gains. Member countries were expected to conduct a fair and transparent competitive process of selecting the student beneficiaries. The selection was also based

on gender, with at least 30 - 40% of beneficiaries being female and occupying leadership positions on the research project to promote gender equity. The outputs of the graduate small research grants initiative included completed dissertations/ theses, scientific peer reviewed journal articles and periodic technical and financial reports based on milestones.

Faculty fellowships for professional development.

The faculty fellowship small research grants initiative aims to support professional development. Financial and technical support is provided to junior teaching faculty and early career researchers in member institutions who seek to participate in a range of professional development activities related to the scholarship of teaching and learning, including, but not limited to, engaging in research, making scholarly presentations of their research findings at a One Health event or professional development event that promotes the One Health approach and may contribute to their career promotion. Those competing for the grants are required to work as multidisciplinary teams of faculty and students under the supervision and mentorship of senior faculty. For instance, the most recent One Health research programmeme focuses on providing innovative solutions for the priority zoonotic diseases in Africa through action research using a One Health approach and contributing to global health security targets. Thirty (30) country and multi-country grants have been offered to winning multidisciplinary teams of faculty and students in member institutions in two years. The country grants (29) offered run up to US Dollars 6,000, while the cross-country grants (1) go up to US Dollars 12,000. The grants focused on the detection, prevention, preparation and response to outbreaks of top-priority zoonotic diseases in Africa, namely rabies, Rift Valley Fever, Anthrax, Ebola Virus Disease (EVD) and brucellosis.

The photo shows a RCCE activity in response to exposure of primary school children to a rabid dog in Nairobi city, Kenya. In the photo are Kenya participants of the AFROHUN TD-RCCE Programmeme; Mr. Charles Okendo, who works with FHI360, (left with white cap) and Dr. Gertrude Shepelo, AFROHUN Kenya Activity Lead who led the RCCE team (on the right in white T-shirt). In the photo they are educating the children on the basics about rabies. Source: AFROHUN Kenya archives.

Dr. Catherine Abaasa, AFROHUN Transitional Award Professional Development (TAPROD) working in the laboratory at the Regional Veterinary Laboratory in Mbarara district, Western Uganda. She is a faculty at Mbarara University of Science and Technology. This was in 2024.Source: AFROHUN Uganda archives.

Student One Health Innovation grants

Student One Health innovation grants were offered to multidisciplinary teams of undergraduate students under faculty mentorship. The student One Health innovation grants were small grants as an educational model for health and sustainable livelihoods using a One Health approach. They involved skilling and enterprise development to improve community livelihoods. This initiative was funded in 2016. Over 23 One Health student teams benefited from the small grants that were executed using a One Health approach. The innovations included solutions to address One Health challenges in communities that were greatly affected by the intersection of humans, animals, and the environment. A maximum of USD 600 was awarded to each team. The solutions addressed included health, agriculture, human capital, natural resources, climate change events and wealth creation. The grant beneficiaries gained One Health competencies, including leadership, systems thinking, community engagement and communication.

The long-term benefits were the innovative solutions to the community. These included, but were not limited to, the co-creation of solutions to community-identified priority problems for the potential development of a sustainable model and understanding and appreciation of the One Health concept, principles and practice in the community.

AFROHUN, through various funding initiatives has provided funds for research to both students and faculty. In the photo, Mouhamadou Moustapha SOW, a SOHIC member and Small grants alumni (now), conducting a data collection exercise from community members, in 2021.Source: AFROHUN Senegal archives.

Financial support

As Chapter 2 elaborates, AFROHUN has depended entirely on funding partners, largely USAID and IDRC, to execute the research. The sizes of the small research grants varied from 300 USD to 16,000 USD depending on the grant category and project. The USAID funded grants were more common during the One Health Workforce – Next Generation) period (8,14) after earlier experiences under the One Health Workforce programmeme (15) showed the need for One Health research to solve complex health challenges.

Management support

AFROHUN initiated One Health-related research at the regional level. Following the network-defined research priority areas and the availability of funding, research projects were run both at the country and regional levels, depending on the requirements of the funding partners (8). Regionally managed small grants research projects meant that the regional secretariat would directly administer the grants. In contrast, the country managed projects would be administered at the country secretariat, with an oversight function of the regional secretariat. All projects were directly under the supervision and mentorship of expert faculty within the network membership. The regional Secretariat provided leadership, coordination and oversight functions to the participating countries. The Secretariat also provided guidelines and templates for operationalising the research initiatives to ensure the standardisation and institutionalisation of One Health. The regional secretariat depended on the infrastructural mechanism that was built during the ORIP project to support competitive small grants.

Technical support

The research projects were supervised and mentored by senior faculty, who were provided with incentives for commitment and quality assurance of the research. Their selection was based on their expertise in the research area/ discipline, their ability and commitment to promote the One Health approach and availability. A gender expert was employed to ensure gender integration in the project design during the selection process for review of the progress reports and the product.

Impact of AFROHUN on One Health research

The impacts of AFROHUN/OHCEA's research and related activities vary depending on the projects (small grants, scholarships, fellowships), the regions they work in, and the resources available. Reference is made to the annual reports, publications, or contacts with the focal persons and beneficiaries on the impact that has been realised out of the One Health research and related activities. We provide some potential impacts and benefits that One Health research and initiatives have generated in the AFROHUN network and beyond, and these include the following, among others.

The human capacity-building component of the research initiatives and the development of the robust infrastructure to support One Health-related research have contributed to the advancement of One Health research in the African region. Beneficiaries of the One Health research initiatives of the network have developed larger research projects and programmemes managed either by the regional secretariat or through member institutions or newly created structures to accommodate multidisciplinary team research. For instance, the IDRC-funded project titled "Eco-health Chair on Human and Animal Health in Protected Ecosystems of Central and Eastern Africa." was managed at the regional secretariat. This project aimed at fostering the building of a body of evidence and knowledge, research capacity, and collaboration needed to tackle health and environmental sustainability problems at the interface of wildlife and livelihoods of vulnerable communities in the Queen Elizabeth National Park region in Western Uganda. It supported five PhD and seven master's degree students. Another example is the other three-year IDRC-funded project code-named "SheVax" and titled "Action research to support women's agency and empowerment in livestock vaccine distribution, delivery and use in Rwanda, Uganda and Kenya" was managed by the regional secretariat because of the network's demonstrated capabilities.

The graduates who benefitted from the small research grants initiatives were prepared to enter the workforce equipped with the knowledge and skills necessary for successfully managing and implementing action research using the One Health approach and concepts in the workplace (7,16). They gained more knowledge, positive attitudes, and hands-on skills which they applied in their work. Participating faculty in the member institutions gained several One Health competencies, including multisectoral collaboration, coordination, communication, leadership, and community engagement, as shown in the network reports. They broadened and strengthened their research capabilities from operating in siloes

and conducting research for academic reasons to working in multidisciplinary teams and conducting action research which provides practical and strategic solutions to identified problems, respectively. Behaviour change resulting from working in multidisciplinary teams and engaging with communities was demonstrated during and after executing their research projects. Small grant beneficiaries who gained grant writing skills and One Health competencies constituted themselves into multidisciplinary teams to respond to grants. They have been awarded larger grants for collaborative and interdisciplinary One Health research projects. AFROHUN Research has empowered several people to obtain their master's or PhDs to become better researchers, grant writers, and managers. This has been possible through One Health research support through the small grants scheme.

At the individual level, spillovers for beneficiaries in terms of research projects and research collaborations have also been reported. Through the One Health research, several projects have been written and carried out in several countries. The network has provided a platform for collaborating faculty and students who now run their research projects, which are not necessarily under the control of AFROHUN. For example, a recipient of the small grants programmeme in Senegal, building on the capacities obtained during the grant, successfully obtained a scholarship in another research programmeme where he is now doing his PhD (7,17). In addition, two beneficiaries of the scholarships are now enrolled in the Senegal National One Health Platform.

Engagement in One Health research has also created different forms of cross-sectoral collaborations i.e multidisciplinary and multisectoral collaborations. For example, in Tanzania, One Health teams comprising veterinarians, medical doctors, and environmental scientists worked together to investigate an anthrax outbreak. Their interdisciplinary approach helped contain the outbreak quickly and minimise its impact on human and animal populations.

Improvement in public health and the environment has been realised out of the One Health research projects conducted over time. An example, the research conducted on the relationship between livestock farming practices and the spread of antibiotic-resistant bacteria in Kenya led to the development of guidelines for responsible antibiotic use in agriculture (18). This development reduced the risk of antibiotic resistance and improved human health. Several research projects in different countries involved different communities. These vary by geographical location activities. Some action research initiatives in Tanzania, Uganda and DRC, for instance, led to One Health education, responsible waste disposal to prevent attracting disease and reducing the risk of diseases like rabies, Ebola, COVID-19, and Marburg.

Through research projects that promoted research training, AFROHUN have equipped many students and professionals in Africa with One Health skills. These individuals have gone on to contribute to disease control, research, and policy development in their respective countries. For example, under ORIP 12 faculty gained scientific writing and policy brief development through a workshop organised in 2015 in Addis Ababa, Ethiopia. The leads of the multidisciplinary research teams developed policy briefs and strengthened their manuscripts based on the peer reviews which were done. The end products from the

One Health research findings, like policy briefs and conference presentations, have created linkages with policymakers as well as provided an avenue for One Health policy advocacy in different countries where AFROHUN operate.

Member institutions supported the research process for OH research projects, which was complicated when ethical approval for both human and animal subjects was required. The research management entity was responsible for supporting an expedited approval process. In Ethiopia, for example, AFROHUN supported Mekelle University in establishing an Institutional Animal Care and Use Committee (IACUC).

The research initiatives were designed to promote gender, equity, diversity and inclusivity in the selection of the grant beneficiaries. This was done through the grants awarding selection process and providing ongoing technical support to the awardee research teams when executing their projects.

Challenges and mitigations

In building One Health research initiatives, AFROHUN experienced some challenges. Silo mentality and interdisciplinary collaboration barriers abounded during the initial stages. Coordinating and maintaining effective collaboration among professionals from various disciplines was relatively complex. Each group had different priorities, terminologies, and methodologies. These differences in approach tended to hinder the implementation of holistic One Health solutions. Over time, this kept reducing as members appreciated the need for multidisciplinary research that tapped into the strengths and contributions made by different disciplines required by the One Health approach.

Capacity building efforts of university faculty were constrained by mindsets of being experts in research in their respective disciplines and the absence of a One Health research framework to guide the design and implementation of the One Health research without appreciating the importance of the One Health approach.

Ultimately, the research outcomes of One Health-related issues such as zoonotic diseases fell short of integrated and holistic solutions derived from a more comprehensive understanding gained from engaging various disciplinary lenses to the research problem. Currently, researchers are trained to design and implement research projects that address complex health challenges using a One Health Research framework. Exposure of researchers to more One Health training opportunities, including One Health field experiential learning, has led to a mindset shift among the One Health champions. These One Health champions have been nurtured to take on a mentorship role, which was lacking in the earlier growth stages of the network.

Communication is key to driving success, especially in research projects. The network comprises Anglophone and Francophone countries. Some of the applications were done in one language and sometimes required translation, which may distort the meaning. This affected the quality and outcomes of the reviewed research proposals, with missed funding opportunities. Also, the language barrier tends to delay the grant management process

including grant writing, processing, capacity building and execution, as well as accountability. Provision of interpreters, translators and review committees with a membership that comprises representatives of both languages were accommodated to address this barrier.

As the network builds its One Health research initiatives, securing sustainable funding and other resources for comprehensive One Health projects is still a constraint. Limited resources have greatly restricted the ability to conduct One Health research, provide training, and implement interventions effectively. It has also limited the scale and sustainability of initiatives and hindered the execution of the network's strategic plans and research agenda. A more diversified resource mobilisation strategy and country sustainability plans have addressed this gap, and plans are underway to operationalise the strategy and plans.

Coordinating efforts across multiple countries and regions can be complicated due to differing priorities, regulations, and political challenges. Policy differences and regulatory barriers affected cross-border research without effective regional cooperation. For instance, the implementation of the SheVax research project was complicated when the research team was unable to procure the Newcastle Disease (ND) vaccine in Uganda due to the challenging hostile relations between the Rwanda and Uganda governments. Mistrust between neighbouring governments in conflict, in another project, hindered the research teams from engaging the targeted border communities.

Limited infrastructure to support One Health research and research capacity building was another constraint. Participating researchers reported limited internet access, low bandwidth in a number of countries in the region, lack of equipment especially for students including computers, and limited skills for online delivery greatly affected research and research communication. Cross-country research IRBs and cultural differences were also a challenge, delaying the research process. Existing Institutional Review Boards are ill equipped for reviews of research that is multidisciplinary, involving human, animal, and environmental disciplines. The need to have Boards that accommodate the needs of One Health research is critical for a smooth process. This could be through forming partnerships among the IRB or creating a separate institution as the research and ethics pillar of the AFROHUN academy is planned.

The researchers were sometimes faced with divided loyalty challenges in, say, a situation where they had to choose to respond to research grants as network members when their respective member institutions were also competing for the same funding. The network valued a non-competitive working environment and instituted a policy that clearly stipulated the requirements, incentives and benefits of the researchers' engagement in the network's research initiatives.

The researchers' motivation to conduct research for academic purposes and professional growth in some cases tended to conflict with other national and global actors whose need was for universities to engage in more action research to provide practical solutions to inform policy and practice relating to the prevailing complex health challenges and meeting global health security targets. Currently, the network runs an annual training series on action research using the One Health approach and sensitive issues of gender equity, diversity

and inclusion that are tailored based on specific research thematic areas and are offered to network members to strengthen the multidisciplinary researcher teams of faculty and students. Engagement of communities and other stakeholders in the entire research process, from conception to research uptake, is emphasised to allow for more integrated and holistic solutions to the research problems. The Academy, under the research and ethics pillar, will serve as a one-stop platform for research output, knowledge management and communities of practice. This will mitigate the challenge of different member countries managing their relatively small and uncoordinated research projects and outputs, as well as the delays in knowledge management and documentation across the network. The One Health Academy will play a great role in mitigating this under the research and ethics pillar.

Lessons learned and emerging good practices

Some lessons that AFROHUN have learned from their resolve to build a One Health research initiative. Building a sustainable One Health collaborative research initiative is a worthy journey for the network. Over the years it has been realised that one piece of research done today opens the research window of tomorrow. One needs to be persistent and patient along the journey. Many people and development partners are available to fund useful research. A lead person needs to build relevant, strong and valuable relationships to access the resources required to create a collaborative One Health research initiative. Advocacy, policy influence, and resource mobilisation are essential in building One Health research initiatives. Through AFROHUN One Health research, the need to search for funds from different sponsors has been recognised. So far, funds for research have come from USAID and IDRC (see Chapter 2).

Support for the next generation and prioritising approaches that address gender inequities, diversity and inclusivity is the way to go. To advance One Health research in Africa that shall significantly contribute to providing integrated and holistic solutions to the complex health challenges, women researchers, students, early career researchers and junior teaching faculty in universities should be targeted as champions and leaders. The competitive small research grants approach has created unique opportunities for those who were previously underprivileged in the research leadership space and played a great role in building One Health's research workforce (7). Both the trained and grant beneficiaries have come out to be relevant in pursuing the One Health research agenda in their institutions. Others have grown in their research career pathways and have become leaders in research.

Continuous improvement is an important strategy and philosophy for sustaining the One Health research initiatives of the network. Through research activities, the network learnt to review itself, determine the positives and the negatives and work for improvement. More students and faculty have benefited, and they have helped write more One Health research grants. Different teams with different partners have continuously worked hard and more improvements in the outputs and products have been registered.

Knowledge management is key, and data sharing needs to be enhanced. Flexibility in strategies to adapt to evolving health challenges and planning for long-term sustainability for successful One Health research and interventions should be captured and shared. This

could be done through providing or utilising existing joint conferences. Research results are largely disseminated through local dissemination meetings and international conferences, both AFROHUN-sponsored and other-sponsored. Policy influence and advocacy can be enhanced through capacity-building and dissemination workshops.

The dual approach to building the collaborative initiative, namely combining research undertakings with capacity building through training, is critical for success. Through the One Health research grants, training was a key component of the research approach outputs. Training has greatly built research competencies, mentorship, dissemination of the research findings, knowledge translation, and knowledge utilisation through policy briefs and other supportive mechanisms.

Recommendations and future steps

To continuously evolve the health landscape and to contribute meaningfully to the search for robust solutions to the complex health challenges in Africa, AFROHUN is committed to strengthening further its role in advancing One Health research, innovations and practice for improved health outcomes for humans, animals and the environment. This calls for the network's envisioning to undertake One Health's cutting-edge, systems-based and impact oriented research that is implemented with and through strategic partnerships with regional and international academic and research institutes that embrace One Health.

Under the leadership of the Research and Ethics pillar of the AFROHUN Academy (10), three strategic areas have been identified for further development of the research portfolio of the network. These are research capacity strengthening, resource mobilisation and establishing a One Health Journal. Capacity strengthening shall focus on finalising the research agenda through stakeholder and expert reviews and board approval; development of sustainable research programmemes, streams and projects; and instituting responsive ethical approval and compliance mechanisms. The resource mobilisation strategy and investment of the One Health journal shall be anchored within the network's newly developed resource mobilisation strategy and sustainability plans.

Conclusion

AFROHUN is strategically positioned to be a leading player in One Health research in Africa. Establishing ORIP as a regional One Health collaborative research initiative in Africa demonstrates a proof of concept for university networks to harness resources that support the development of coordinated, interdisciplinary and regional research centres with the potential to inform policy decisions and actions toward addressing complex health challenges, using a One Health approach, in Africa.

AFROHUN One Health research remains a key pillar to the transformation of the AFROHUN network as well as the transformation of Africa. It has transitioned over the years from an initial tentative, experimental approach to a more pro-active and planned function in the Network. The two-pronged strategy used to advance One Health research in Africa, namely providing small research grants support and training of multidisciplinary

research teams to conduct One Health research based on the infrastructure built over time, has contributed to the scaling of One Health workforce development that will lead to improved health outcomes of humans, animals and the environment. Coupled with sensitivity to changes and diversity in One Health challenges, focusing on support for the next generation and utilising approaches that prioritise the strategic needs of the underprivileged in the research space, the network is a critical player in influencing both the local and global health security.

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PART III

TOWARDS A PROMISING FUTURE

CHAPTER 6

The AFROHUN One Health Academy: Consolidating Progress, Envisioning The Future

Christine Muhumuza, Irene Naigaga, Jonah Ainembabazi, Nicola Watt , William Bazeyo, John David Kabasa.

Introduction

As the world becomes more interconnected and health challenges more complex, the demand for the next generation of competent workforce is increasing. This need is even more glaring on the African continent, given the increasing frequency and emergence of infectious disease outbreaks and the recent COVID-19 pandemic (1). AFROHUN continues to be at the centre of One Health Workforce development, filling this gap within the ten member countries for the last one and half decades (2).

Being at the centre of One Health Workforce development for over fifteen years, AFROHUN has observed how unique and competitive its products, the health professionals that have gone through its trainings have become. The network has also witnessed an increased demand in its services. To reposition itself to fill the Workforce capacity gap on the African continent beyond the ten (10) network countries, that it currently serves, the AFROHUN One Health Academy (AOHA) (3) was established in 2020 and accredited initially in Uganda in 2023 by the National Council for Higher Education (NCHE) as other degree awarding institution. AFROHUN is pooling the strength of the network members, partners, and lessons learned over fifteen years into a platform to coordinate the development of the continent's One Health Workforce under one umbrella, this is what gave birth to the AFROHUN One Health Academy. To this end, AFROHUN is innovatively integrating African capacity to deliver to the Global Health Security Agenda goals and other

global and continental frameworks through the AFROHUN One Health Academy (3–5). The creation of the AFROHUN One Health Academy is an important step in the evolution of AFROHUN.

The Academy is a continental Platform for One Health workforce development and capacity building, consolidating AFROHUN's programmemes to benefit the wider continent and beyond. The Academy is the premier regional platform for One Health learning and capacity building (3). It is a One Health professional competency body with international recognition under the leadership of African academic institutions and experts who have led multidisciplinary One Health workforce development over the last decade. The Academy promotes an African agenda that responds to continental and global workforce needs, serving training institutions and organisations, multidisciplinary workforce, One Health players and funding institutions. It is receptive to collaborations that are open to the co-creation and design of additional new unique One Health programmemes responsive to the ever-changing human resource competence needs on the continent. It serves different clientele and customer segments: governments especially sectors relevant to One Health, in-service professionals from multiple disciplines, including frontline workers, laboratory technologists, technocrats, administrators, policy makers, and private sector players interested in building competencies to support multidisciplinary and multisectoral work environments.

The Academy aims to create a proactive workforce that works collaboratively to promote regional integration, markets and trade, and evidence-based interventions for global health security.

The AFROHUN One Health Academy has significantly benefited from the diverse stakeholders, innovations and unique on-demand programmemes from early implementation efforts detailed in this book's chapters three to five and leverages experts from within network members institutions across the continent to deliver cost effective programmemes.

A symbiotic relationship exists between the Universities and the AFROHUN One Health Academy. Faculty members will be requested to actively contribute to developing and implementing One Health short courses, ensuring the standard of excellence marked by quality and academic rigour. Despite being under the oversight of the AFROHUN member African academic experts, the AOHA is housed at the AFROHUN Secretariat based in Uganda and will extend the university's influence across Africa.

This chapter presents the organisational and programmematic set-up of the AFROHUN One Health Academy and reflects on progress so far, opportunities for collaboration, and the unfinished business going forward.

How is the Academy structured? What are the pillars and their implementation progress?

Since its inception in 2020, the AFROHUN One Health Academy has effectively set up its operational structures, developed strategic roadmaps, and achieved significant milestones across all its pillars, solidifying its role in fostering a proactive and integrated One Health workforce across the African continent. The Academy's pioneer programmeme the Transboundary Disease Risk Communication and Community Engagement (TD-RCCE) using Rabies and COVID-19 as case studies, was also launched and attended by 600 participants (259 females, 341 males) from 22 countries. The successful delivery and impact of this training provided learnings and a template for other unique programmemes to be delivered at the AOHA. The Academy is organised along five pillars, namely, the Accredited Training Programmemes (ATP), One Health Experiential Learning Models (OHELM), Research, Ethics and Innovations (RE&I), Student One Health Innovation Clubs (SOHIC), and Communities of Practice (CoP) as indicated in figure 6.1.

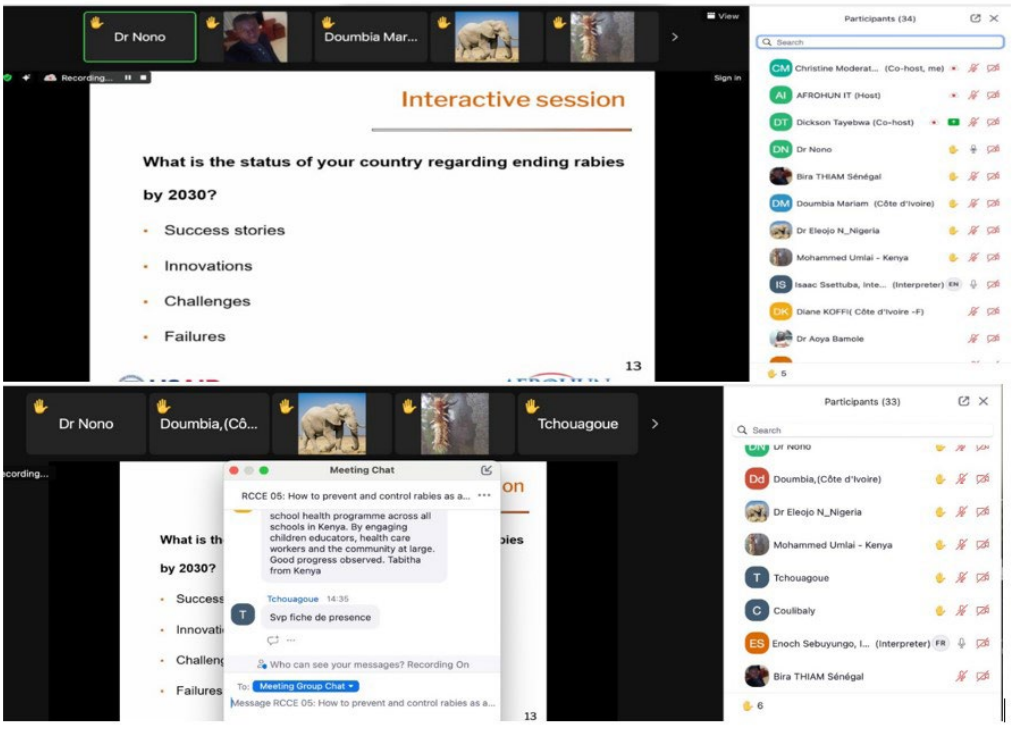
**The AFROHUN One Health Academy is broader than training and includes other pillars like Research, Ethics and Innovation, One Health Experiential Learning Models (OHELM), Communities of Practice (COP) and Student One Health Innovation clubs (SOHIC).). Source: AFROHUN One Health Academy.*

Figure 6.1: Shows the five pillars of the AFROHUN One Health Academy

These pillars arose out of the AFROHUN programmemes, representing unique learning models developed over the years.

1) The Accredited Training Programmemes pillar oversees and monitors the development, delivery, institutionalisation, and accreditation of AFROHUN One Health professional

training programmemes for interdisciplinary multisectoral workforce. Achievements under this pillar include the establishment of operational structures and systems. Working within the realms of the Global One Health Academies[1], the External Board of One Health Examiners was established. Multiple training programmemes, including online courses such as the TD-RCCE (3). Also, a comprehensive needs assessment for the TD-RCCE, involving AFROHUN countries and additional nations was conducted. Emerging insights from the assessment have potential to guide the Academy's future direction (3).



Top: The AFROHUN One Health Academy (AOHA) has mounted the TD-RCCE In-service Programmeme, which has been running since February 2024. The programmeme targets in-service professionals with mandate to manage rabies and COVID-like diseases in their national and sub-national jurisdictions. The screenshots in this photo are of the virtual sessions that precede the Mentored Experiential Learning Training (MELT) sessions where participants work with different stakeholders in the country to identify challenges and draw interventions to address them. Source: AFROHUN Secretariat..

1 GOHA is a flagship initiative under the One Health Workforce Next Generation project

The photo depicts a typical MELT setting where participants and trainees engage community members on issues related to rabies and COVID-like diseases, for comprehensive understanding and decision-making. In this photo, trainees from 6 AFROHUN countries were engaging community members on rabies in Kilosa District, Morogoro region, in Tanzania, in 2024. Third right, is the AFROHUN Board Chair, Professor Philemon Nyangi Wambura. Source: AFROHUN One Health Academy.

The photo depicts a typical MELT setting where participants and trainees engage community members on issues related to rabies and COVID-like diseases, for comprehensive understanding and decision-making. In this photo, trainees from 6 AFROHUN countries were conducting a community dialogue with community members in Kilosa District, Morogoro region, in Tanzania, in 2024. Source: AFROHUN One Health Academy.

Design thinking session during the MELT Training in Tanzania for trainees from 6 AFROHUN countries. Design thinking training enables participants in the TD-RCCE programmeme develop interventions that take note of the unique problems, contexts, needs and abilities/resources of the respective communities they work with. Source: AFROHUN One Health Academy.

2) The One Health Experiential Learning Models pillar oversees and monitors the development, delivery, and institutionalisation of AFROHUN skilling models. It has strengthened and is working in field experiential learning sites in Tanzania, Cameroon, Uganda, DRC, Kenya, Senegal including 2 that are cross-border (Uganda/DRC and Uganda/Kenya) and Uganda-Kenya (Cross boarder sites). These provide hands on Mentored Experiential Learning and Training (MELT) to trainees (4). This pillar also supports the development of individual capstone projects to enhance trainees' hands-on experiences with One Health, as part of the MELT programmeme.

3) The Student One Health Innovations Club (SOHIC) pillar oversees and monitors the development, delivery, and internationalisation of student's regional, continental and global innovative One Health programmemes. This pillar seeks to continue providing unique platforms for student innovation and experience sharing. As elaborated in chapter 3 through events like the international students' symposium, the Global One Health Case Competition, and Student Hackathons (5,6), SOHICs are a long-running workforce development approach in AFROHUN and have nurtured students One Health champions.

4) The Communities of Practice (CoP) pillar oversees and monitors the development, delivery, institutionalisation, and internationalisation of Communities of Practice across scholarly and professional disciplines of One Health. Virtual communities of practice on three topics e-learning, competency-based education (CBE) and Antimicrobial

Resistance (AMR) were held and in the process helped to build AFROHUN's capabilities in the Project Extension for Community Health Care Outcomes (ECHO) VCoP model. These CoPs facilitate experience sharing and best practices among professionals across AFROHUN member institutions.

5) The Research, Ethics, and Innovations pillar shapes the AFROHUN research agenda and oversees the development of the AFROHUN ethical research programmemes. These aspects are elaborated on in chapter 5. In brief, significant achievements include updating the AFROHUN One Health Research Agenda that will guide the Academy's research initiatives and support faculty and students in executing multi-disciplinary small research grants across the AFROHUN network (6,7).

One Health Research and partnerships

The Academy promotes One Health Research and ensures it addresses the priority One Health challenges, links researchers and stakeholders, and strives to effectively disseminate generated findings to inform integrative responses in human, animal, and environmental health shared ecosystems (6).

The AFROHUN Academy also acknowledges that complex and transboundary health challenges, such as disease outbreaks, require multisectoral solutions through leveraging partnerships among universities and the public and private sectors in public health programmeming (4,19). It is further cognizant that it takes strong partnerships and interconnected efforts to bring together the best scientific solutions across different sectors and technical areas to achieve meaningful progress in global health security. Partnerships and collaboration are a key strategy in the Academy. The AFROHUN Academy continues to identify key national, regional, and global strategic partners for collaboration in this programmeme's design, delivery, and sustainability. These will enhance technical programmeming, training value, response impact, and financial support. These results will, in turn, foster long-term sustainability and complementarity to allow scale-up of AFROHUN Academy activities and impact beyond the African region.

Emerging lessons and considerations for the future direction of the AFROHUN One Health Academy

Going forward, we draw following lessons from the initial implementation experiences of the Academy as well as the AFROHUN's long standing legacy in workforce development.

Second, effective One Health Workforce development should be grounded in evidence and driven by the needs of the communities and sectors. Continuing to align the activities of the Academy, such as research and training, with the existing priorities is essential for remaining a fit for context and purpose. Ongoing engagements and monitoring efforts will remain critical to ensure adaptation and responsiveness to change.

Third, beyond their professional training, many professionals lack the competencies needed to work effectively beyond their traditional silos. The Academy's programmemes are designed

to impart these crucial cross-disciplinary skills comprehensively. The needs assessments and the pilot training programmemes like TD-RCCE indicate a real and pressing demand for the One Health Academy. There is robust support from potential stakeholders, and the competencies required align well with the established competency framework. Establishing standardised credentials for One Health education will be crucial for streamlining and enhancing the effectiveness of training programmemes across the board.

Fourth, Successful One Health Workforce development involves engaging and coordinating strategic partnerships, including universities, government bodies, alumni, the private sector, communities, and funders. Developing and nurturing strategic partnerships has been, and will continue to be, a cornerstone of our approach. Collaboration with universities, government agencies, alumni networks, and the private sector has proven essential in advancing our mission. Moving forward, we will expand these partnerships to include more diverse stakeholders, ensuring a robust support system for the Academy.

Fifth, initially, the AOHA offers programmemes in English and French. Plans are in place to expand these offerings to other languages, as need arises. The logistical and human resource demands for these efforts will remain a critical consideration going forward.

Understanding and respecting the diverse cultural contexts across the African continent is fundamental to the success of our programmemes. The course on the African People, their Culture, and how it relates to Global Health serves as a foundational element, ensuring that our training programmemes are culturally adapted and relevant to the various regions we serve. Relatedly, our programmemes incorporate localised content and examples that reflect African communities' real-life experiences and challenges. This approach enhances the relevance and impact of our training, making it more relatable and practical for participants.

Lastly, our training programmemes are designed with flexibility at their core, as outlined in our training implementation strategy. This approach ensures that our offerings can adapt to our diverse stakeholders' varying needs and circumstances. This approach promotes student-led learning and stimulates initiative on the learners' side. To facilitate this model, several efforts have been made. These include standardisation of materials, elaborating the IT infrastructure, maintaining a pool of multidisciplinary experts and mentors across the continent, boosting advertisement and visibility through traditional and social media. Progressive roll out of the courses has enabled experimentation and generation of lessons before full-blown scale-up. This approach offers promising results albeit with the need for continuous innovation, monitoring, evaluation and learning.

Opportunities for partnership and collaboration

One Health Workforce Development and Sustainability of Training Programmemes: As health challenges become increasingly complex, there is a growing need to continuously upskill the workforce across disciplines and sectors. This places a demand on training institutions to innovate and equip the human resources with the necessary knowledge and skills to address these challenges. Flexibility in training approaches is therefore essential to meet this demand effectively, though it can be challenging for training institutions to offer. The

academy presents a unique opportunity for innovation and flexibility in workforce assessment, planning, development, and sustainability at national, regional, and continental levels. Our offerings range from customised on demand short courses to online asynchronous training programmemes, as well as certificate, diploma and other degree programmemes. Being an accredited institution, the AOHA provides a platform for institutionalising and sustaining One Health training programmemes across the continent. For example, in collaboration and partnership with GIZ and the East African Community, the AOHA, has institutionalized the "Pandemic Preparedness with a One Health Approach[1] Course.

Multi-disciplinary Research and Resource Mobilization: The academy actively seeks to engage with a different partner, from academic institutions and research Organisations to governmental and non-governmental entities; and the private sector, at national, regional, and continental levels. These collaborations aim to address conduct research and mobilise resources to address critical yet complex health challenges through development projects, innovative multidisciplinary research programmemes, and grant proposals. The AOHA is open to collaborating on grant applications in various One Health-related fields, including, but not limited to, infectious diseases, climate change and environmental health, food safety and security, workforce development, antimicrobial resistance (AMR), emerging and re-emerging diseases, policy and governance, and many more. By partnering with the AOHA, Organisations, researchers, philanthropists, pharmaceutical companies, to mention but a few can leverage the academy's extensive network and expertise to strengthen their proposals.

Fellowships, Scholarship and Internship Administration: The academy boasts a robust administration structure for hands-on experiential learning models including, fellowships, internships and scholarships. For example, in collaboration with Tufts University, the AFROHUN One Health Academy, housed the One Health Leadership and Advocacy (OHLA) fellowship programme, where the academy hosted and mentored fellows in eight countries, including, Cameroon, Cote d'Ivoire, Liberia, Kenya, Senegal, Tanzania, and Uganda. Fellows were exposed to the rich One Health educational, cultural interests, developments and achievements at different Organisations enhancing their leadership skills, and strategic coalitions and partnerships. Through the MELT, TFOHEL and SOHIC programmemes, the AOHA provides unique multi-sectoral, hands-on experiences for in-service and pre-service participants. These programmemes are designed to bridge the gap between theory and practice, ensuring participants gain practical skills that are directly applicable to their fields. The Academy has also administered scholarships, and professional development programmemes for multi-disciplinary teams of scholars.

Knowledge transfer to players outside the network: The academy, through its Smart Library, offers extensive resources for product and process development, leveraging the network's experience and expertise. This innovative platform provides access to a wealth of knowledge. Additionally, the academy provides opportunities for technical input into national and regional One Health processes, ensuring that different academy technical experts contribute to shaping health policies and practices at multiple levels.

1 https://projectecho.unm.edu/model/

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CHAPTER 7

Sustaining AFROHUN's Legacy: Embracing the challenge, seizing the opportunities to advance the One Health agenda in Africa

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Introduction

This concluding chapter synthesises insights from the preceding chapters to chart a path forward for AFROHUN's quest to advance One Health in Africa. As AFROHUN continues to champion continental efforts to strengthen One Health workforce, research, policy and practice, it must navigate both opportunities and challenges presented by the evolving institutional, national, regional and global developments. Looking ahead, AFROHUN must take decisive actions to sustain the One Health revolution in Africa. The future and potential impact of the One Health approach in Africa are significant and hold promise for addressing the complex health challenges on the continent (1,2). This chapter elaborates an action agenda for AFROHUN to shape this trajectory and sustain the One Health revolution. Emphasis is placed on anticipating, mitigating and responding to emerging global and regional developments that influence core One Health areas, such as climate change, antimicrobial resistance, urbanization, politics, war, illicit trade, and threats to conservation and planetary health.

This chapter, in many ways, provides a critical reflection on the AFROHUN's journey. As recounted in chapters 2-6, AFROHUN's trajectory has been marked by significant milestones and achievements in the One Health domain. The key milestones and growth areas have positioned AFROHUN as a leading force in advancing One Health initiatives, especially in the domain of workforce development across Africa. These provide a strong springboard for AFROHUN to work further on the One Health efforts. This chapter highlights

that critical actions and strategies to guide AFROHUN's endeavour have both internal and external aspects. The next section focuses on internal growth. Internally, sustained nurturing of capabilities at individual, organisational and network levels is essential to deliver AFROHUN'S mandate. The next section discusses the fundamental external actions, including articulating a clear programmeme of work aligned to Africa's needs, deepening competent One Health workforce development efforts, strategic partnerships and alliances, navigating political economy aspects to shake policy and practice and leveraging African and global development agendas. The chapter ends with a brief conclusion summarising the way forward for AFROHUN and other like-minded One Health champions in Africa and beyond.

Critical actions and strategies to sustain AFROHUN's Strategic Alignment with the Evolving One Health Landscape

AFROHUN's evolution is intricately linked to the complex and dynamic environment in which it operates. Organisational learning, complexity and adaptive system thinking have guided AFROHUN's approach, enabling it to respond effectively to uncertainty and feedback loops that shape dynamic developments over time. For example, current development discourse underscores power dynamics between north-south partnerships and argues for more equitable partnerships. This section reflects on the evolving context and offers directions for AFROHUN and similar entities to navigate these contextual realities effectively.

Consolidating and expanding innovative and contextually-adapted One Health workforce development programmemes

The implementation of innovative One Health programmemes has addressed pressing health issues by integrating human, animal, and environmental health perspectives. Several chapters have shown how AFROHUN has embraced innovation in programme design and implementation, adapting to the dynamic health landscape and incorporating cutting-edge research and practices into its work.

Chapter 3 underscored how AFROHUN has identified and integrated critical competencies into its curricula for pre-service to ensure that graduates possess the necessary skills to address complex health challenges. These competencies include interdisciplinary collaboration, systems thinking, one health research and epidemiology, which are essential for effective One Health practice. The stories of change from the alumni, trainers and trainees all demonstrate wholesome learning across the spectrum. Several Master's Degree Programmemes have been rolled out, such as the Master of Veterinary Preventive Medicine (MVPM) programme, hosted at Makerere University's College of Veterinary Medicine, Animal Resources and Biosecurity (COVAB), the MSc. Infectious Diseases and Antimicrobial Resistance at the University of Buea in Cameroon. These programmemes have developed case studies on areas such as zoonotic diseases such as yellow fever, typhoid, brucellosis, cholera, tuberculosis, rabies, Ebola, and Rift Valley Fever. These case studies culminated in a draft of the One Health Problem-Based Learning (OHPBL) Handbook, which serves as a

resource for training future professionals.

Chapters 3, 4 and 5 elaborated on AFROHUN's systematic and strategic approach to experiential learning through theoretical training together with fieldwork and research. AFROHUN's experiential learning programmemes have targeted students and in-service professionals from various disciplines at demonstration sites across member countries (1,2). By engaging directly with communities, students gain practical insights into the complexities of implementing One Health initiatives and they gain competencies on the application of One Health. . This hands-on experience is invaluable for translating academic knowledge into real-world impact. The enhancement of e-learning infrastructure across the AFROHUN member institutions supports distance learning and collaborative teaching by facilitating the sharing of teaching materials interactions between faculty and students (3).

Africa is the youngest continent in the world today with 40% of its population of 1.5 billion people aged under 15 years (4). This trend is likely to continue into the near future. AFROHUN has positioned itself to continue impacting youths through its Student Innovation One Health Clubs (SOHICs) (5,6). These clubs address building know-how and awareness of One Health issues among students in the One Health professions from their formative years in the University. AFROHUN's SOHICs aim to instil One Health principles in students from the outset of their university education. Engaging young people in One Health is essential for fostering innovation and ensuring that future leaders are well-versed in the interconnectedness of health, environment, and society. The impact of this is that by the time youths graduate into the workplace as doctors, veterinarians, or environmental professionals, they have internalized the One Health concept and are able to collaborate across disciplines seamlessly.

AFROHUN has articulated a clear direction forward by establishing the One Health Academy (7). As Chapter 6 highlights, this Academy has been fully accredited by the National Council for Higher Education (NCHE) in Uganda to offer training courses and programmemes relevant to One Health. This accreditation is critical in the courses of the One Health Academy being adopted in other African countries due to reciprocal accreditation agreements in place. Thus positioned, AFROHUN can continue to provide specialised training for the One Health Workforce fit for the evolving context and purpose. The Academy should be adequately resourced. AFROHUN should deepen collaborative networks with government and other development actors to enable absorption of the trainees into employement opportunities. AFROHUN Academy should invest in its visibility and a functional monitoring, evaluation and learning system to effectively track progress and adaptivity and responsiveness to the evolving conditions.

Articulating and responding to programmematic and policy priorities for One Health in Africa

The One Health agenda cannot be confined to academic discourse alone; it must be contextualized to address real-world challenges in Africa. This requires integrating diverse knowledge systems and embracing a holistic approach that encompasses the complex interplay of human, animal, and environmental health. As indicated throughout this book,

AFROHUN has positioned itself to respond to these challenges in several major ways. This sub-section reflects on these critical programmematic areas and core actions that were introduced in Chapter 1 and reflected upon throughout the book. These aspects are discussed here for emphasis.

Developing Climate-Resilient Strategies

Climate change presents significant threats to health systems, ecosystems, and biodiversity across Africa (8,9). The continent's vulnerability to climate-induced disasters, such as droughts, floods, and heatwaves, farming systems and food security vulnerabilities, interwoven with other complexities like population explosion and poverty exacerbates existing health challenges and disrupts ecosystems that are crucial for maintaining biodiversity (10). AFROHUN can lead efforts to integrate climate resilience into One Health initiatives by promoting sustainable integrative practices and policies that mitigate climate impacts. For instance, AFROHUN can advocate for the incorporation of climate adaptation strategies into national health plans, emphasizing the protection of ecosystems that support both human and animal health. Ensuring that collaborative efforts against climate change become a central component of One Health efforts across the continent, AFROHUN will contribute to the continental efforts towards climate resilience (10,11).

Combating Antimicrobial Resistance

The rise of antimicrobial resistance (AMR) is a critical issue that transcends human health and impacts animal health, agriculture, and the environment (12). The AMR threatens to reverse decades of medical progress by rendering antibiotics and other antimicrobial agents ineffective. Chapter 1 emphasised that in Africa, where infectious diseases are prevalent, the misuse and overuse of antibiotics in both healthcare and agriculture are driving the spread of resistant pathogens. Several examples in chapters 3, 4 and 5 have demonstrated that AFROHUN can play a pivotal role in addressing AMR by spearheading research, advocacy, and capacity-building initiatives. However, more work is still required. AFROHUN's efforts should include promoting the responsible use of antibiotics, supporting surveillance systems to monitor AMR trends, and facilitating the development of alternative treatments and preventive measures. Through a One Health approach, AFROHUN can coordinate efforts across sectors and partners with other like-minded Organisations, such as Africa CDC to combat AMR and protect public health (13).

Innovating for Urban Health Solutions

Rapid urbanization presents unique health challenges for Africa. Urbanization often leads to overcrowded living conditions, inadequate sanitation, and increased exposure to environmental hazards, all of which can exacerbate health disparities (14–16). However, it also offers opportunities for innovation in health service delivery and infrastructure development. AFROHUN can foster multisectoral collaborations to address the health challenges posed by urbanization. By working with urban authorities, public health professionals, and local governments. AFROHUN can develop innovative solutions to improve health outcomes in urban areas. This could include initiatives to enhance access to clean water and sanitation, reduce air pollution, and promote healthy urban environments through green spaces and sustainable transportation systems (17,18).

Building Strategic Partnerships at local, national, regional and international levels

The increasing recognition of the interconnectedness of human, animal, and environmental health on a global scale highlights the growing importance of partnerships in the One Health paradigm (19). As the world shifts towards more integrated approaches to health, AFROHUN is well-positioned to lead efforts in Africa, promoting policies and practices that reflect the holistic nature of health. This involves engaging with global networks, contributing to international One Health discourse, and ensuring that Africa's voice is heard and shapes the future of global health (20). Several instances in the book underscore that AFROHUN's approach emphasises the integration of global insights with regional, national and local contexts, creating solutions that are both globally informed and locally relevant. For AFROHUN, this means drawing on international expertise, networks, funding opportunities and best practices while tailoring interventions to the specific needs and circumstances of African communities. Being embedded in international networks also allows AFROHUN to contribute to global One Health efforts by sharing successful models and innovations from Africa with the rest of the world (11,21). To achieve this, equitable partnerships are needed and should be solicited. A few issues and strategic actions are emphasised subsequently.

Continuing to align with African-led Development Agenda

The pursuit of an African-led development agenda, as articulated in frameworks like Agenda 2063 (22) and the New Public Health Order for Africa (17), provides a solid foundation for AFROHUN's role as a continental champion of One Health. Chapter 1 elaborated on how these frameworks advocate for sustainable development, health equity, and resilience, which are closely aligned with One Health principles. AFROHUN can harness the momentum generated by these African-led initiatives in addition to the global agenda, to drive One Health forward, ensuring that health systems across the continent are robust, inclusive, and capable of responding to the diverse health challenges posed by climate change, urbanization, and emerging diseases (13,23).

The future of AFROHUN cannot be divorced from the future of Africa as a continent. At the time this book goes to press, the continent has a population of about 1.5 billion people a significant portion of it being young. The UN projects that by 2050, Africa will have a population of 2.5 billion people (4). About 25% of the world's population will be found in Africa. Such a phenomenal growth in population will come with various consequences. First, will be the need to settle and accommodate these one billion Africans. It is foreseeable that pressure on the environment and reserved areas such as forests and wildlife areas will be intense as people look for settlements. Secondly, these extra one billion Africans will need to be fed. This will be no mean task, considering that even today, Africa struggles to feed itself. There will need to be radical improvements in Agriculture, and the pressure on forests and areas reserved for wildlife will be even greater, leading to the encroachment of humans into wildlife ecosystems. This change carries the risk of a greater transmission of diseases from the wildlife ecosystem into the livestock and human ecosystem and may result in new epidemics and pandemics. The third challenge closely associated with population growth will be the effects of climate change brought about as more carbon dioxide is released

into the atmosphere due to intensive industrialization to cope with meeting the needs of a bludgeoning population. Furthermore, with forests likely reducing, this effect will likely be exacerbated. AFROHUN should intensify its linkages across the African Union and regional economic blocks such as ECOWAS, EAC, and COMESA for sustained, holistic health responses to these interconnected development challenges across the continent (22,24).

There is a growing trend in Africa towards the establishment of specialized One Health Organisations (18,25). These Organisations focus on research, capacity-building, advocacy, and coordination of One Health activities. They play a pivotal role in harmonizing efforts among various stakeholders, including government agencies, academic institutions, and nongovernmental Organisations, to address health challenges that cut across human, animal, and environmental domains. These Organisations facilitate resource mobilization, collaboration, and knowledge sharing, ultimately enhancing the region's preparedness to combat emerging pandemic threats and achieve better health outcomes. Strategic partnerships with such Organisations enhance AFROHUN's growth and reach. However, such entities could threaten AFROHUN's resource mobilization and project implementation efforts.

Aligning with the global development agenda

Previous sections above and in several chapters have situated AFROHUN's efforts with a global landscape. The sub-sections below reflect on a few aspects of these realities, considering their implications for AFROHUN and the One Health agenda in Africa.

Pursuing equitable partnerships in the context of decolonization

The global discourse on decolonization and equitable partnerships emphasises the importance of creating relationships that are grounded in mutual respect, shared goals, and the recognition of local knowledge (26). Acknowledging the value of locally driven solutions in addressing health challenges is a valuable development tenant. The AFROHUN has had the opportunity to lead by example in fostering equitable partnerships that prioritise local expertise and ensure that development efforts are inclusive and responsive to the needs of African communities (27,28).

However, as AFROHUN contributes to the deconstruction of the traditional power dynamics in global health by gaining a premium role on the continent, it faces renewed scrutiny on how it promotes a more balanced collaborative approach that values the contributions of all stakeholders (26,29). Continuous internal reflections on the nature and health of the network set-up and operations should be encouraged. AFROHUN's strategic agenda should continue to prioritise harvesting African knowledge on health, shaping government systems and influencing education systems to embrace the One Health agenda.

International Collaborations and the Global Health Security Agenda

The increasing coordination and collaboration at the international levels for One Health provide a fertile ground for replicating similar efforts at the continent level. The quadripartite collaboration, which includes the World Health Organisation (WHO), the Food and Agriculture Organisation (FAO), the World Organisation for Animal Health (OIE), and

the United Nations Environment Programmeme (UNEP), continues to play a critical role in shaping the future of One Health in Africa (30,31). The Quadripartite joint initiatives, guidelines, and support to African countries bolster the capacity for surveillance, early detection, and coordinated responses to zoonotic diseases. Their collaborative efforts help harmonize standards, policies, and best practices that promote a One Health approach, thus assisting African nations in effectively managing public health risks and conserving biodiversity. AFROHUN should actively foster formal partnerships with these organisations.

Relatedly, the Global Health Security Agenda (GHSA) aims to build capacities across nations to prevent, detect, and respond to infectious disease threats (32). Several chapters have highlighted how the GHSA agenda aligns with the One Health approach, emphasizing the interconnectedness of human, animal, and environmental health. AFROHUN has played a critical role in advancing the GHSA in Africa. This involves strengthening surveillance systems, improving cross-sectoral collaboration, and enhancing the capacity of health professionals to manage health threats (28,33). These are commendable achievements that should be supported more. By doing so, AFROHUN can contribute to the broader goal of global health security, ensuring that African nations are better prepared to handle emerging health challenges (13).

Addressing the Political Economy and Broader Determinants of One Health

AFROHUN's growth has not been without challenges. Maneuvering professional egos, differences in university systems especially from the large institutions with historical legacies, differences due to political divide amidst resource limitations have occasionally hindered faster progress. The Organisation has learned valuable lessons by deploying resilience, adaptability, and maintaining a strategic focus to overcome these hurdles. Understanding the political economy and political determinants of health is essential for sustained change (34). A politically informed approach involves engaging with political factors, actor interests, ideological positions, institutional factors, and deeply rooted power dynamics, often rooted in historical legacies (35). Actions in this regard should consider the following issues.

As Chapter 1 elaborated, political instability and conflict are significant barriers to health and development in Africa (36). Pandemics exacerbate existing vulnerabilities in already politically fragile states in Africa and the continent as a whole. By engaging political leaders and stakeholders, offering true One Health solutions in addressing epidemics and pandemics to in- country, regional and African Union political leaders, technocrats together with their development partners, AFROHUN will be valued partner contributing to the broader goals of peace and development on the continent (11,22).

Furthermore, as Africa experiences economic growth, it is essential to ensure that the benefits are distributed equitably across all communities (22). AFROHUN can advocate for policies that address social determinants of health, such as poverty, education, and access to healthcare that require collaborative efforts. AFROHUN has promoted gender-sensitive policies and initiatives to mitigate the disparities in One Health challenges, which disproportionately affect women and children (37). By promoting equitable development,

AFROHUN can help ensure that health improvements benefit all segments of society, particularly vulnerable populations. This approach aligns with the broader goal of achieving health equity and improving the overall well-being of African communities (17,38).

Concerted advocacy and coalition building are critical political actions for sustained change. Through advocacy and partnerships with governments and international Organisations, AFROHUN has influenced policies and actions that prioritise One Health approaches. By aligning health systems with the multifaceted challenges of contemporary health threats, AFROHUN should ensure that education systems and policy frameworks are robust and responsive to evolving One Health needs. For example, AFROHUN has also prioritised building relationships with training institutions to ensure that training programmemes align with workforce needs. This engagement focuses on identifying the skills and competencies that are most valued by employers, thereby enhancing the employability of graduates. Moving forward, AFROHUN should strategically engage education policy Organisations to ensure that the One Health agenda is enshrined within the education policy directives.

As the continent continues to grapple with emerging infectious diseases, antimicrobial resistance, climate change crises and other environmental challenges, policymakers are recognizing the need for a more integrated and holistic approach to health. The adoption of the One Health approach is increasingly becoming a priority for African governments. This is evident in the development and implementation of national and regional One Health policies and strategies, and ascenting to international frameworks in support of holistic and integrated approaches. These changes signify a window of opportunity to entrench One Health in government systems and university training programmemes as a sustainable longterm solution. The One Health policies lay the foundation for crosssectoral collaboration, coordination, and resource allocation, ensuring that health systems in Africa can better respond to pandemics, protect public health, and promote sustainable development (21). AFROHUN should consider itself a powerful political actor by engaging in policy advocacy efforts that influence decision-making and priorities among stakeholder constituencies and serve as a think tank informing governments and decision makers on One Health policy practice informed from OH application. The political toolkit should include creatively collaborating with policymakers, conducting high level policy research, and participating on expert panels (39,40).

AFROHUN as a learning Organisation: sustaining internal growth, innovation and adaptation to evolving landscape

Reflecting on AFROHUN's journey offers valuable lessons for the future. The preceding chapters have shown AFROHUN's progressive growth into one of the strongest One Health champions across the continent. The continued focus on enriching internal capacities and resources has supported the attainment of the many achievements discussed across the entire book. These achievements relate to securing sustained funding over time, expanding the number of member institutions and countries, establishing strategic linkages at national, regional and international levels, cultivating strong pre-service One Health Workforce development workstream, a concerted agenda for in-service One Health Workforce

development and implementing a one health research portfolio. Some outcomes include the growth of a competent One Health workforce, deeper knowledge and awareness of One Health among key stakeholders and the adoption of supportive policies and practices. Ultimately, AFROHUN has contributed to enhanced capacities at individual, institutional, national, regional and global levels to address health challenges and ensure improvements in the health of the people, animals and environment (37,41). Below, the chapter reflects on the priorities for internal growth to sustain AFROHUN's legacy.

Strengthening and leveraging AFROHUN's internal capabilities to support the path forward

Concerted efforts to sustain internal growth, innovation and adaptation to the evolving landscape are vital for AFROHUN's future (28,42,43). Continuous growth has proven critical for AFROHUN to stay ahead of emerging challenges and seize new opportunities. Several chapters demonstrated that investing in internal capacity building and fostering a culture of innovation has enhanced AFROHUN's effectiveness and growth. AFROHUN has invested in building the capacity of its members and partners through training programmemes, workshops, hands-on experiential learning and collaborative research initiatives. By investing in human resources, technology, and infrastructure, AFROHUN has strengthened its ability to deliver impactful One Health initiatives across the continent. Continued investment in human capital remains essential for AFROHUN's success. By attracting, retaining, and developing skilled professionals, AFROHUN can ensure it has the expertise to tackle emerging challenges.

Chapter two demonstrated the gradual process of weaning off dependence from northern partners to more horizontal partnerships within the African continent. As observed, under the transition grant, the US university partners are increasingly playing a catalytic role and supporting the AFROHUN secretariat to perform administrative roles as a primary recipient of US government grants. This signifies growing confidence in AFROHUN's ability to manage international grants and subcontract other entities. Relatedly, the AFROHUN network sets its agenda through a combination of top-down and bottom-up collaborative processes converging at the regional and national levels. These aspects rhyme well with the perspectives in global health that international priorities should be contextually adapted to harness local solutions and donor funding should align with contextual realities.

Financial viability through a sustained diversity of partners

All development initiatives require funding to be realised. Chapter 2 showed that AFROHUN has enjoyed its main funding from the US government (44–46). Recently, newer funders such as IDRC and GIZ have come on board. The Regional Secretariat has a dedicated Grants and Resource mobilization office that works to mobilize funding, and to create and nurture value adding partnerships in different thematic areas of funding. The mission of preparing a One Health Workforce and ensuring that the continent's capacity to prevent epidemics and other One Health challenges is so critical creating an urgent case for funding. AFROHUN's growth can be attributed to a resolute team of founders who have been committed to nurturing relationships with funders (e.g USAID) and learning institutions in the US and within Africa

(42). AFROHUN is looking for strategic alliances with Organisations that share goals to deliver on critical initiatives and for expanding AFROHUN's reach. It is open to resource pooling to deliver a united front in tackling health challenges. Exploring partnerships with international donors and philanthropic Organisations to deliver on the aspirations outlined in chapter 6. AFROHUN is also seeking collaborations with private sector entities to scale up One Health innovations like the promising innovations developed by SOHICS.

Expanding geographical reach to optimize relevance and influence

AFROHUN has strategically grown beyond the initial members' institutions and geographical reach. As Chapter 2 elaborates, the network initially focused on the eastern and central parts of Africa. However, over time, it extended into western Africa, to countries like Cote d'Ivoire, Senegal and Liberia. As noted in chapter two, this informed the change in name from OHCEA to AFROHUN. The network aspires to expand its reach across the continent, extending beyond its current presence in ten countries and twenty-six universities. This growth has been partly inspired by the recognition that health challenges such as emerging and reemerging diseases such as Ebola and COVID-19, climate change, antimicrobial resistance and food insecurity do not respect national borders (42,47) but also in response to the growing demand for network services across the continent. This broader geographical scale is vital for effectively managing health threats amidst underlying drivers such as globalization, increased movement of people and animals, war and trade across the continent.

By design, AFROHUN has positioned itself to collaborate with the South East Asia One Health University Network (SEAOHUN) and with northern partners including those based in the United States of America. AFROHUN is interested to grow its partnerships with institutions in Europe, emerging economies. Such international linkages are vital for cross-learning and extended influence beyond the African continent. Chapter 3 shows that the in-country university networks and SOHICs are expanding beyond the founding member institutions in countries like Cameroon, Ethiopia and DRC. These developments offer opportunities for sustained change and advancement of One Health aspiration at various levels.

The connections with national One Health bodies, a critical mass of One Health Champions and a strategic focus on developing a competent One Health workforce endear AFROHUN to decision makers and One Health implementing partners across government and nongovernment spheres. This collaborative approach will allow AFROHUN to focus its scarce resources where they are needed most. Targeted interventions and efforts will enhance efficiency and effectiveness in achieving health outcomes.

Fostering a Culture of Innovation and Adaptation

As the One Health paradigm gains global traction, AFROHUN must continue to strategically align itself with emerging trends and developments such as the global health security agenda and Africa's long-term development agenda 2063. However, despite several achievements, there is cognizance of the long journey ahead. AFROHUN should remain critical of the unfinished business.

AFROHUN's One Health Academy (chapter 6) reflects the deliberate attempts to

consolidate learning and progress. Indeed, the progressive expansion and deepening of AFROHUN's mandate reflects a journey of adaptive learning and growing abilities to optimize change processes over time. AFROHUN must remain agile and adaptive to the ever-changing national, regional, and global landscapes of health and development. This requires ongoing assessment, strategic planning, and flexibility to respond to new challenges and opportunities.

Key areas where AFROHUN can position itself to maximize impact include the following:

1) AFROHUN should prioritise research and development to stay ahead of emerging health threats and inform evidence-based policy and practice. This will require the expansion of the skill sets and competencies of the individuals and institutional members to foster interdisciplinary work and interprofessional collaboration.
2) AFROHUN should support innovation incubation by providing resources and mentorship to innovative projects that align with One Health objectives. Impact stories in chapters 3, 4 and 5 demonstrate that incubation initiatives can accelerate the development and scaling of impactful solutions.
3) Integrating cutting-edge technologies into One Health practices to enhance efficiency and effectiveness. AFROHUN should facilitate technology adoption and integration across its programmemes and initiatives. Leveraging technology and innovation, such as virtual working platforms, AI has proved crucial for facilitating AFROHUN's collaborative and education efforts (43). AFROHUN should continue to invest in state-of-the-art tools and platforms to enhance its research, education, and programme delivery capabilities.
4) Developing and providing resources for robust monitoring and evaluation. This book project has benefited from comprehensive documentation of AFROHUN's work and achievements over time. The chapters have provided concrete examples of impactful contributions to One Health development in Africa over time. Implementing robust monitoring and evaluation frameworks allows AFROHUN to assess the impact of its initiatives and identify areas for improvement (18). Monitoring and evaluation also enhance accountability and effectiveness. Data-driven decision-making is essential for optimizing One Health strategies. AFROHUN should leverage data analytics to inform evidence-based interventions and resource allocation.

Consolidating corporate and network governance at regional and national levels.

Chapter 2 underlines that AFROHUN's governance structures have evolved to support its expanding scope and responsibilities. A multi-tiered approach to governance has ensured effective coordination, accountability, and stakeholder engagement across its various programmemes (41,47). The network has also deployed key governance and management capacity enhancement initiatives to ensure inclusive leadership, effective stakeholder engagement, transparent decision-making, decentralized governance and continuous improvement. AFROHUN has a decentralized governance model. Transparent governance mechanisms facilitate informed decision-making and accountability. AFROHUN's leadership structure emphasises the core values of collaboration, interdisciplinarity, inclusivity and diversity, ensuring that decision-making processes consider a wide range of perspectives. In addition, AFROHUN actively engages stakeholders from government, academia, industry,

and civil society in its governance processes. By involving diverse stakeholders at the sub-national levels, AFROHUN ensures that its initiatives align with the needs and priorities of communities.

Chapters 3 and 4 illuminated AFROHUN's commitment to strengthening relationships with partners and stakeholders, thereby ensuring regional standardization, comparative analysis and mutual learning across countries and member institutions. Establishing national-level university networks allows institutions of higher learning to tailor initiatives to local contexts. This approach enhances the relevance and impact of AFROHUN's programmemes while allowing for flexibility in implementation. The governance and management structures have been subject to continuous evaluation and improvement to enhance their effectiveness. As chapters 2 and 4 point out, such learning explains the phasing from Country Coordination Committees once the National One Health Platform became established. AFROHUN's commitment to adaptive governance ensures that it remains responsive to changing needs and emerging challenges.

AFROHUN should expand capacity-building programmemes that equip leaders and managers with the skills and knowledge needed to steer the implementation of One Health initiatives effectively. These programmemes should emphasise interdisciplinary collaboration and practical applications. Investing in leadership development initiatives will empower individuals to champion One Health approaches and drive transformative change within their Organisations and communities.

Conclusion: The Path Forward for AFROHUN and One Health in Africa

AFROHUN is at a critical juncture in the One Health revolution in Africa. AFROHUN's strategic alignment with the evolving One Health landscape is vital for advancing its mission and driving positive health outcomes across Africa. By embracing critical actions highlighted in this and other chapters, AFROHUN can navigate challenges, seize opportunities, and create a healthier future for people, animals, and the environment.

AFROHUN's strategic focus on African solutions and alignment with Africa's development agendas positions it as a key player in advancing One Health across the continent. By fostering equitable partnerships, integrating global and local insights, and leveraging regional frameworks, AFROHUN can contribute to a more resilient, equitable, and sustainable health landscape in Africa. Leveraging emerging opportunities, forging strategic partnerships, and understanding the political economy of health will further help AFROHUN to continue to lead and sustain the One Health agenda on the continent.

The path forward also involves continuous internal growth, innovation, and adaptation to the evolving landscape of health and development. AFROHUN's evolution over time symbolises adaptive processes in an evolving environment. The driving forces of One Health globally were elaborated in chapter one to provide proper context for this book. These include increased recognition of the complexity of health changes and the need for interdependent collaborative actions. Despite several achievements, there is cognizance of the long journey ahead. There is a need to remain critical of the unfinished business. The likely fundamental cause of this suboptimal progress lies in the simplistic view of the work and an underestimation of the complexity of the task at hand.

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