



One Health
and Veterinary
Systems
IN

A F R I C A

Taking stock of current coverage, needs, and opportunities to meet present and changing threats and optimize collaboration

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KEY ACRONYMS

AFROHUN	Africa One Health University Network	NAPHS	National Action Plan for Health Security
AMR	Antimicrobial Resistance	NBSAP	National Biodiversity Strategy and Action Plan
AU	African Union	NGO	Non-governmental organization
BSL	Biosafety level	OH	One Health
CBPP	Contagious bovine pleuropneumonia	OHHLEP	One Health High-Level Expert Panel
CDC	Centers for Disease Control and Prevention	OHZDP	One Health Zoonotic Disease Prioritization exercise
CFE	Contingency Fund for Emergencies	PEP	Post-exposure prophylaxis
COVID-19	Coronavirus disease 2019	PPR	Peste des petits ruminants
EISMV	Inter-State School of Veterinary Sciences and Medicine of Dakar	PVS	Performance of Veterinary Services
EWS	Early warning system	REDISSE	Regional Disease Surveillance Systems Enhancement (World Bank program)
FMD	Foot and Mouth Disease	TrACCS	Tripartite AMR Country Self-assessment Survey
FAO	Food and Agriculture Organization of the United Nations	UNEP	United Nations Environment Programme
FELTP	Field Epidemiology and Laboratory Training Program	UNICEF	United Nations International Children's Emergency Fund
FETP	Field Epidemiology Training Program	USAID	United States Agency for International Development
GHSA	Global Health Security Agenda	VS	Veterinary services
HIV/AIDS	Human Immunodeficiency virus/ Acquired Immunodeficiency Syndrome	WAHIS	World Animal Health Information System (via WOAH)
HPAI	Highly Pathogenic Avian Influenza	WHO	World Health Organization
IBAR	Interafrican Bureau for Animal Resources (via African Union)	WOAH	World Organisation for Animal Health (Formerly OIE)
IDSR	Integrated Disease Surveillance and Response		
IGAD	Intergovernmental Authority on Development (Eastern Africa)		
IHR	International Health Regulations		
ISAVET	In-Service Applied Veterinary Epidemiology Training		
IUCN	International Union for Conservation of Nature		
JEE	Joint External Evaluation		
LSU	Livestock Unit		

Additional acronyms are used in the regional and country reports, to promote familiarity with agency names (which may be based on their names in other languages).

Key Findings and Conclusions

Over the past decade One Health has received high attention in Africa in relation to health challenges at human-animal-environment interfaces. This has made the important role of veterinary services more visible, while also exposing weaknesses in the capacity, resourcing, and workforce of the sector. The interest and advancement made in One Health systems in a relatively short time signals a commitment of countries — and their human capital — to taking up One Health coordination. Though routine activity slowed during the first two years of the COVID-19 pandemic, formal and informal One Health coordination mechanisms have been resilient overall. In addition, multi-sectoral coordination has been leveraged in emergency response, including the support of veterinary laboratories for surge capacity. *This report examines One Health and veterinary systems in the continent, synthesizing current coverage, needs, and opportunities to meet present and changing threats and optimize collaboration.*

ONE HEALTH COORDINATION

Countries are at different stages of institutionalizing One Health in national governments, particularly in the formation and legal establishment of national One Health coordination platforms and development of strategic plans. Where already established, the core implementation barriers for One Health platforms are similar among countries:

- Lack of sustainable financing
- Limited and uneven financing for implementation activities under platforms
- Lack of certainty about high-level political will with political changes
- In some cases, low awareness and engagement among stakeholders

At national levels, environment sector representation is weak, and in some cases, the appropriate environment authority(ies) have not been identified given the wide scope of environment and fragmented mandates. These barriers have caused a lag in operational activities. Subnational and decentralized mechanisms are being explored, such as county-level One Health units that can mobilize budget.

The coordination of most One Health platforms and major projects in the continent is housed in institutions with a human health mandate, a reflection of relative resourcing and institutional capacity to host the platform and implement activities under it. This may explain the human health bias apparent in their technical work, assessments, and action plans. There are some exceptions; in Ghana, the platform is coordinated by the National Disaster Management Organization. Unique collaborations have been mobilized through the platforms. For example, in Liberia the national One Health coordination platform includes >26 partners in its governance structure. In Mali, the Ministry of Defense and Veterans Affairs is a member of the One Health steering committee.

Financial constraints aside, the political commitment given to One Health coordination platforms, including through high government (e.g., prime minister, vice president) suggests they could be leveraged for a wider scope across development issues. The initial focus of these platforms and health security plans has been largely on responding to existing zoonotic diseases, particularly driven by human health outcomes. With some exceptions, disease events in animals alone or environmental degradation do not routinely gain attention or resourcing under national One Health strategies. Evolving the mandates of these platforms to play a wider role in national and subnational development trajectories could help to broaden their value (i.e., shifting to a “One Plan” approach). This

coherence is needed at continent and regional level as well, such as through the African Union, with its many topical arms, sectoral priorities (that may create positive or negative impacts for health), and existing One Health activity through the African Union InterAfrican Bureau for Animal Health Resources (AU-IBAR) and the Africa Centres for Disease Control and Prevention (Africa CDC).

WORKFORCE

Excluding Egypt, the continent has an average of 2,368 veterinarians per country, or 0.16 veterinarians per 1,000 people. This compares to an average of .40 medical doctors per 1,000 people. At least nine countries have <100 veterinarians.*

The continent's veterinary workforce is low relative to other continents, both in absolute and per capita number of veterinarians. Insufficient supply of veterinarians is a serious threat to the provision of services to meet current need. The exception is Egypt, Algeria, Ethiopia, and Sudan, which each have >10,000 veterinarians. South Africa's number of veterinarians is far above the continental average, yet faces critical workforce challenges, such as replacement of retiring veterinarians and workforce shortage for rural, public-sector jobs.

Workforce data is in some cases out of date; in fact, 17 countries in the continent had not reported the number of veterinarians to the World Organisation for Animal Health (WOAH) within the last five years. The number of practicing veterinarians is typically far lower than what is officially reported. Where available, the use of national veterinary association data will be important for ground-truthing in workforce planning.

The increasing number of veterinarians entering private practice in urban settings — for small animal specialties — presents a further deficit in rural, agricultural areas. Compulsory public service programs in place in some countries provide personnel, but do not solve the issues

of high turnover and lack of institutional knowledge. Other animal health workforces (e.g. para-veterinary, technicians) are growing, but training and job prospects are not currently aligned to a preventative care focus.

In a few countries (e.g., Morocco and Senegal), legislative and financial mechanisms are in place to involve private veterinarians in the functions of national veterinary services. However, in most countries there is not a direct (or sufficient) link between public and private veterinary workforce, and low or no incentive to contribute to vaccination campaigns and voluntary reporting. This misses important workforce contributions and leaves risk reduction and detection in the hands of individual farmers or other animal owners not typically well equipped to act.

Several countries employ veterinarians in national parks or protected areas (e.g., Côte d'Ivoire, Kenya, South Africa, Zambia). However, there is no standard tracking of veterinary or wildlife health workforce in the management of wild animal populations. Countries generally have an extremely limited (or narrow) or no wildlife disease and pathogen surveillance program and budget.

The number of human medical doctors in African nations, absolute and per person, is far below the global average, reinforcing the importance of disease prevention functions that can be served by investment in other sectors (i.e., animal health; environmental protection; agriculture and nutrition; food safety; and water, sanitation, and hygiene).

There is continent-wide uptake of Performance of Veterinary Services (PVS) evaluations (53 countries - all except South Sudan), though 19 countries conducted their latest evaluation a decade or more ago. Some have subsequently conducted other missions more recently, e.g. PVS Gap Analysis or PVS Legislation; however, 16 countries have no PVS mission activities reported since 2013. Only 4 countries have completed the PVS Aquatic evaluation (Côte d'Ivoire, Ghana, Mozambique, Seychelles).

* Seychelles, Comoros, Equatorial Guinea, Cabo Verde, Gabon, São Tomé and Príncipe, Guinea, and Guinea-Bissau (per official reporting to WOAH), and Liberia (per expert consultation).

TRAINING

Under the Joint External Evaluation (JEE), approximately 60% of countries (n=30 of 51) had limited capacity to develop a multi-sectoral workforce strategy (average score=2). Performance was higher on the FETP indicator (average score of 2.78).

For Francophone countries, EISMV in Dakar, Senegal serves the continent as a key training pipeline, through agreements with 15 member countries (Benin, Burkina Faso, Burundi, Cameroon, Central African Republic, Chad, Democratic Republic of the Congo, Côte d'Ivoire, Gabon, Mali, Mauritania, Niger, Senegal and Togo), and engages with ministries responsible for higher education. No parallel program exists for Anglophone Africa. This is a major gap; some countries have no veterinary workforce pipeline.

Legal requirements for the accreditation of veterinary programs is an ongoing need in some countries. In Ethiopia, the number of veterinarians has risen rapidly, with an increase in the number of veterinary schools from 1 to 11, raising concerns about a standard curriculum, quality of training, and job prospects.

With evolving environmental and animal health challenges, continuing professional education for the veterinary sector is a key need for veterinary services. Field epidemiology training programs (FETP) are in place in many countries, some with robust programs that can also lead to masters degrees. These fill a specific need to strengthen epidemiological expertise in an applied setting. Overall, these programs have seen increasing involvement of animal health workers, and more rarely, environmental experts. Dedicated veterinary epidemiology in-service training programs (e.g., ISAVET) are now being rolled out. Training opportunities on other topics is more limited. For example, on the Tripartite AMR Country Self-assessment Survey, only Morocco, Kenya, and Tanzania reported that AMR curricula were a formal requirement for graduating veterinarians or that continuing education was available.

Across the continent, a growing community animal health workforce is helping to address gaps in flow of animal health information and reporting at subnational levels, but lacks standardized training, including for One Health approaches.

SURVEILLANCE AND MONITORING OF DISEASE RISKS

The African continent is changing significantly with rapid population growth, livestock and agricultural transitions, and global and local environmental change. In general, baseline epidemiological, ecological and socio-economic information related to disease risk is limited. There is generally poor wildlife and vector distribution data as well as dog census data to support basic risk assessments, risk maps, and design of prevention and control measures. Recent outbreaks of highly pathogenic avian influenza (HPAI) in poultry demonstrate the risks and vulnerabilities of livestock development strategies in the continent without proper risk analysis and biosecurity measures. Recent wild bird mortality events from H5N1 and H5N8 outbreaks in West and Southern Africa, as well as environmental degradation (e.g., decline in vultures from poisoning), also reinforce the need to more fully consider wildlife impacts and their connections in transboundary and other disease threats.

In the veterinary services, attention required for frequent livestock and zoonotic disease events means the public sector has limited bandwidth to consider future threats. In addition, there is limited attention to the anthropological factors shaping disease risk and the willingness to adopt safer practices, though some research initiatives are integrating social sciences into their activities. At the One Health coordination platform level, there is a need to bring the sectors and departments associated with risks (versus response to impacts) to monitor changes more systematically and identify needs to support prevention and preparedness (e.g., early detection, resilience measures).

Some longitudinal surveillance is conducted in animals. For example, the use of sentinel herds in Mauritania is used for Rift Valley fever virus monitoring, and a government farm in Ghana conducts endoparasite monitoring. Early warning systems are not widely available for livestock and zoonotic diseases. Baseline epidemiological information is lacking, even for many common diseases. The paper-based records in some systems impede analysis of trends, as does limited epidemiological training.

FINANCIAL RESOURCES

Approximately 65% (\$132 million) of global Contingency Fund for Emergencies (CFE) disbursements went to 27 African nations from its inception in 2015 up to January 2021; the majority of events in the continent were animal or environment-linked.

Limited domestic financing for veterinary services, and weak mandates and enforcement at crucial interfaces (particularly veterinary sanitary inspection at borders), are common themes. The activities performed under One Health platforms are reported as influenced by uneven resourcing of sectors.

For rapid response, the Contingency Fund for Emergencies (CFE) was set up to provide immediate resourcing in the event of disease outbreaks and health emergencies. On one hand, the number of disbursements indicate the CFE serves a vital role in the continent. However, it also reinforces the need for risk mitigation to reduce the frequency of crises.

DISEASE PREVENTION AND CONTROL PROGRAM IMPLEMENTATION

Under the IHR State Parties Self-Assessment Annual Reporting, countries scored an average of 48 (out of 100) on a multisectoral collaboration mechanism for food safety events.

One key finding is that systems are still lagging in addressing the threats and impacts of today, and thus

have poor readiness to address the growing challenges of tomorrow related to climate change, biodiversity loss and degradation of forest ecosystems, and growing livestock sectors that may collectively increase exposure risks and amplify transmission potential. Ongoing challenges with foot and mouth disease in Southern Africa, and rabies across much of the continent, for example, persist while emerging infectious diseases also present new issues to contend with. Multisectoral collaboration is recognized as insufficient for food safety events.

In general, there is a clear divide between national human immunization strategies (which are aligned to the Essential Immunization Program) and animal vaccination strategies. While some countries have robust animal vaccine production facilities, these face production and distribution challenges, including predicting and meeting demand. For example, few countries in the continent produce canine rabies vaccines, relying instead on provision by external donors, which typically ends up being sporadic (e.g., for World Rabies Day vaccination campaigns). Supply chain, traceability and rural access issues also affect provision of rabies post-exposure prophylaxis.

Compensation policies for animal production losses vary by country. Protective factors against zoonotic disease exposures are poorly documented and invested in. If strategies are in place, there is poor coherence across sectors and across borders.

There is strong evidence of One Health coordination mechanisms convening multiple sectors for specific events, particularly action planning and prioritization, as well as undertaking coordinated disease investigations on an ad hoc basis. However, there is poor evidence of a One Health approach being taken in day-to-day operations, such as risk communication and after-action reviews.

Animal welfare is gaining increased attention in the continent, with support of continental initiatives and the United Nations Environment Programme, but to date there is limited legislation on animal welfare.

Although institutional review boards are typically in place for human subjects research at public health institutions and universities, animal ethics committees are not standard. Poisoning of animals is implemented by some governments as part of canine rabies control programs.

LABORATORY SYSTEMS

Capacity challenges at the subnational level are an issue for veterinary laboratories. Mobile laboratories are offering new options, but are not widely distributed. The limited sequencing capacity – which is prioritized for human samples where available – means that there is poor understanding of the genetic diversity of some endemic pathogens and their transmission cycles. Access to reagents is a major limiting factor to the day-to-day operations of veterinary laboratories in the continent. Many countries are moving from paper-based to digital surveillance and laboratory records. However, different systems are typically used for human and animal laboratories.

VULNERABILITY TO DISRUPTIONS

Many countries reported that during the COVID-19 crisis, the regular convening of One Health platforms stalled as the focus shifted to emergency response. Greater activity is now being resumed. The COVID-19 experience signals: the long-term sustainability of One Health coordination platforms even after periods of reduced activity in their normal operations; important practical ways that One Health approaches were beneficial in response, such as through the use of veterinary laboratories to rapidly add surge capacity; and the vulnerability to disruption that can impede progress on other important objectives that require a One Health approach and could potentially be advanced even during times of specific public health crises.

The changing movements of nomadic pastoralist communities, which manage substantial populations of livestock animals, may present new geographic needs along transhumance routes. No evidence was found

regarding use of climate-smart health system planning for veterinary services and domestic or wild animal health management.

LEVERAGING GLOBAL AND REGIONAL RESOURCES

Global and regional institutions play an important role in supporting countries in their capacity strengthening and generating national and international commitments. Countries are at various stages of capacity and vary in their historical international cooperation on veterinary services. For example, 10 nations in the continent joined WOAAH within the past two decades (Table).

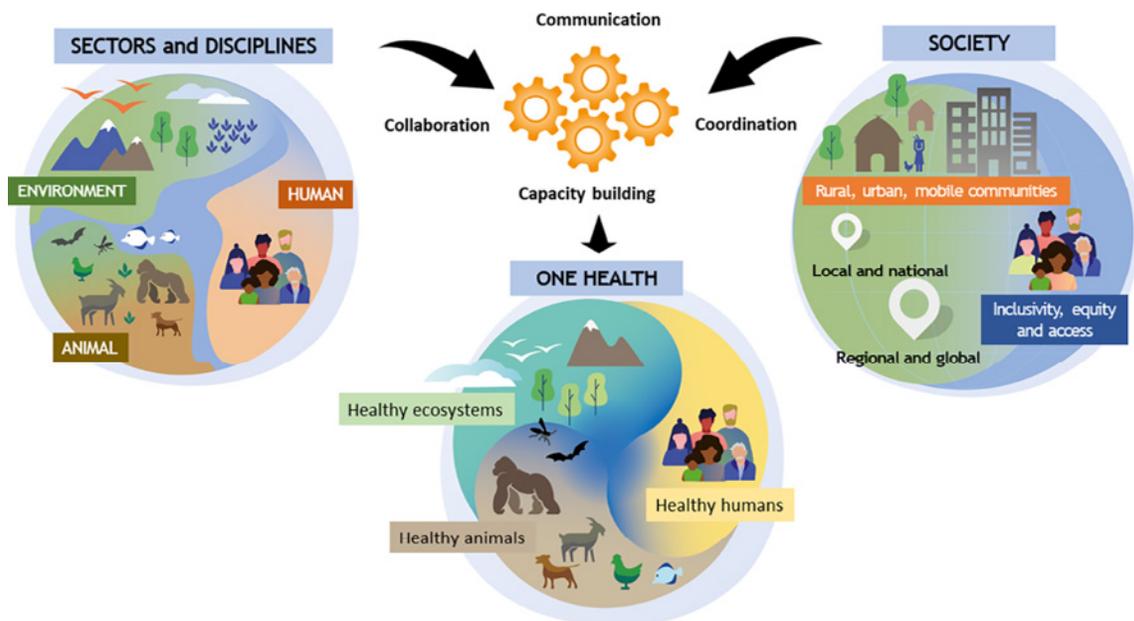
Economic communities (e.g. ECOWAS, SADC) are playing a clear role in convening member states for knowledge exchange and commitment on One Health, including for some transboundary diseases (e.g. rabies). However, disease risks may be shaped by environmental and social characteristics and trade practices that follow different geographic scope, requiring additional information sharing and risk management partnerships. Overall, our findings reinforce the need to address chronic gaps in animal, human, and environmental health systems, capitalizing on the strong One Health momentum in the continent.

Table.
Newest member countries to join WOAAH. Source: WOAAH Regional Representation, 2022.

Country	Year Joined
South Sudan (Republic of)	2014
Liberia	2014
Seychelles	2010
Cape Verde	2006
Gambia	2004
Guinea Bissau	2003
Djibouti	2003
São Tomé and Príncipe	2002
Rwanda	2002
Equatorial Guinea	2002

Figure.
One Health definition and visual. Source: OHHLEP Annual Report, 2021.

One Health is an integrated, unifying approach that aims to sustainably balance and optimize the health of people, animals, and ecosystems. It recognizes the health of humans, domestic and wild animals, plants, and the wider environment (including ecosystems) are closely linked and interdependent. The approach mobilizes multiple sectors, disciplines, and communities at varying levels of society to work together to foster well-being and tackle threats to health and ecosystems, while addressing the collective need for healthy food, water, energy, and air, taking action on climate change and contributing to sustainable development.



OHHLEP Annual Report, 2021

Overview

The African continent maintains a wide diversity of cultures, ecosystems, and economic practices that support a multitude of multi-sectoral connections. Indeed, the One Health concept had its origins in Africa in 2003, in the context of Ebola virus-related declines of endangered Great Ape populations. These outbreaks, which often preceded human disease events and coincided with substantial environmental, agriculture, and economic changes, reinforced the value and need for an integrated approach to health.

Some 20 years on, the African continent has changed in substantial ways, some which place it at increased risk and vulnerability, and some which have increased its resilience. Recent epidemics and pandemics and the ongoing burden of endemic diseases reinforce remaining gaps in need of attention. The urgency of a One Health approach is evident, and has been widely embraced, with determined leadership from several countries and regional institutions leadership on Health coordination to strengthen their local and global health security.

Recent epidemics and pandemics and the ongoing burden of endemic diseases reinforce remaining gaps in need of attention.

Recently, a working definition was developed by the One Health High-Level Expert Panel (OHHLEP) with endorsement from the Food and Agriculture Organization of the United Nations (FAO), United Nations Environment Programme (UNEP), World Health Organization (WHO) and the World Organisation for Animal Health (WOAH): See figure at left.

Deficits in public health systems have been widely identified in response to recent disease crises. This inclusive definition provides a basis for also examining veterinary and broader One Health systems, including environmental aspects. Through the lens of the African continent, this report takes stock of current coverage, needs, and opportunities for national and regional systems to sufficiently meet current and changing threats.

Continental Initiatives

There are many relevant initiatives — both existing and new — contributing to capacity strengthening aimed at the prevention, detection, response, and recovery to human, animal, and environmental health threats in the continent. A brief overview of overarching institutions contributing to veterinary and One Health systems is provided below:

AFRICAN UNION ORGANIZATIONS

The African Union (AU) organizations have played an important role in advancing supporting structures to operationalize One Health at national levels, particularly in the context of zoonotic disease surveillance. In 2020 the Africa Centres for Disease Control and Prevention (Africa CDC), a body under the AU officially established in 2016, published a Framework for One Health Practice in National Public Health Institutes. In 2021 Africa CDC hosted its inaugural One Health conference. An AU Interagency Coordination Group on One Health was announced in June 2022, bringing together seven AU agencies with mandates for human and animal health, as well as expertise in phytosanitary issues, disaster early warning systems, gender and youth integration, and civil society mobilization to support implementation of the One Health Strategy for Zoonotic Disease Prevention and Control across the Member States. The Interagency Coordination Group task force secretariat is hosted through Africa CDC and AU-IBAR. Continent-wide efforts have been reinforced by initiatives under regional economic agencies, including for knowledge exchange and prioritization of issues and investments (see regional reports for further information).

In July 2022, AU Member States released the Lusaka Call to Action on Strengthening Public Health Emergency Operations Centres (PHEOCs) in Africa, requesting the establishment of PHEOCs under Ministries of Health or National Public Health Institutes

in all AU Member States by 2026. One Health coordination and animal health scope are not specifically mentioned.

Several disease specific initiatives are undertaken under the AU umbrella. For example, the Pan African strategy for the control and eradication of PPR was drawn up in 2013 by AU-IBAR and ILRI, with FAO and WOAHP support and the collaboration of the Pan African Veterinary Vaccine Center (AU-PANVAC). This has led to the development of a Pan African PPR prevention, control and eradication programme in collaboration with the PPR Global Eradication program. In 2019, Africa CDC launched the Biosafety and Biosecurity Initiative, in collaboration with Africa Union Member States and regional and international partners. The goal of the Initiative is to strengthen biosecurity and biosafety systems to comply with the International Health Regulations (IHR) (2005), the Biological Weapons Convention (BWC), and United Nations Security Council Resolution (UNSCR) 1540. A 5-Year Strategic Plan has been developed.

QUADRIPARTITE ORGANIZATIONS

The Quadripartite agreement (an expansion of the ‘Tripartite’, with UNEP joining in March 2022) provides a mechanism for intergovernmental agency One Health collaboration. While the majority of the work of each of the four partner organizations is undertaken independently at present, with cooperation often limited to select initiatives (e.g. IHR-PVS National Bridging Workshops), a forthcoming global One Health Joint Plan of Action identifies broader topics and activities for coordination under six action tracks. Implementation is anticipated at regional and national levels.

ACTIVITIES OF THE QUADRIPARTITE ORGANIZATIONS IN AFRICA

Food and Agriculture Organization of the United Nations (FAO)

FAO maintains a variety of offices in the continent, including a regional office in Accra. The Emergency Centre for Transboundary Animal Diseases (ECTAD) provides support to countries, including for response to disease events, joint risk assessment, and strengthening of veterinary laboratories. An In-Service Applied Veterinary Epidemiology Training (ISAVET) program has been launched in 14 African countries. Activities are undertaken on a range of topics, such as food security, livelihoods, livestock and aquaculture production, AMR, and reforestation, as well as disease control (e.g. rabies, PPR) campaigns in the continent. FAO reference centers in the continent range from veterinary vaccine quality assurance to vectors and vector-borne diseases and confirmation of specific diseases.

United Nations Environment Programme (UNEP)

UNEP, headquartered in Nairobi, has a West Africa regional office located in Abidjan as well as two country offices (Ethiopia and South Africa). UNEP hosts the Great Apes Survival Partnership (active in Côte d'Ivoire, DRC, Liberia and Senegal and supporting additional activities and information exchange in other Great Ape range states), which includes disease monitoring as one of its priorities. Important international agreements under UNEP play a key role in guiding environmental health and environmental protection priorities in the continent, such as under the Minamata Convention on Mercury, which has seen increasing ratification and action by African countries in recent years.

World Health Organization (WHO)

The WHO Regional Office is based in Brazzaville, with country offices in the 47 Member States that are part of the WHO Africa region. Northern Africa is in the Eastern Mediterranean Region. In addition, three inter-country Support Teams (for Central Africa, Eastern and Southern Africa, and West Africa, respectively) provide technical support and play a role in coordination with other UN agencies. Regional operations are oriented around clusters, which are segmented by Communicable Diseases (e.g. malaria, neglected tropical diseases, and environmentally-linked diseases), Health Emergencies (emerging infectious diseases), and other themes. The Regional and Country Offices also play a key role in assessment (e.g. the JEE) and National Action planning processes, and maintain a Weekly Bulletin of public health events.

World Organization for Animal Health (WOAH)

WOAH has a Regional Representation in Africa based in Bamako in the Regional Animal Health Center (a partnership with WOAH, AU-IBAR, and FAO). Sub-Regional representations for Southern Africa (Gaborone), North Africa (Tunis) and Eastern Africa (Nairobi) are also in place. Within countries, in addition to the official country Delegate to WOAH, National Focal Points appointed by countries are also in place for eight topical positions (animal disease notification, wildlife, veterinary products and AMR, animal production food safety, animal welfare, aquatic animals, communication, and laboratories). The Regional Representation supports implementation under regional programs (e.g., REDISSE, EBOSURSY) and has also developed a One Health coordinator role for the continent.

OTHER KEY ONE HEALTH ACTIVITIES

A large number of local, national, and international organizations and projects are active in the continent. Because of the focus on long-term systems as a whole, these are not reviewed comprehensively. Select examples are mentioned in country and regional reports and case studies.

- The Africa One Health University Network (AFROHUN) (originally formed as One Health Central and Eastern Africa), serves as a network of academic institutions in ten African countries with 19 participating institutions to date. With support of USAID and national contributors from Ministries of Health, Agriculture, and Environment, AFROHUN has been integral in One Health workforce development, including awareness raising among students and One Health champions, introducing One Health curriculum, creating Students of One Health Innovations clubs, and increasingly supporting applied project activities.
- The African Society for Laboratory Medicine (ASLM) is a non-profit organization established in 2011 in Addis Ababa. ASLM is the first pan-African society for laboratory professionals, endorsed by the African Union and supported by multiple African Ministers of Health through its Ministerial Call for Action.
- The International Livestock Research Institute (ILRI), a CGIAR research center, is co-hosted in Ethiopia and Kenya and maintains offices in nine African countries, on topics including programs such as climate-smart agriculture, antimicrobial resistance, and One Health capacity strengthening [e.g. the Capacitating One Health in Eastern and Southern Africa (COHESA) and One Health Regional Network for Horn of Africa (HORN) projects].
- In terms of biodiversity and conservation, the International Union for Conservation of Nature (IUCN) has regional offices: the Center for Mediterranean cooperation (northern Africa), West and Central Africa, and Eastern and Southern Africa. In 2022 Rwanda hosted the first IUCN African Protected Areas Congress; the resulting Kigali Call to Action for People and Nature acknowledges the utility of the One Health approach.
- The African Science Partnership for Intervention Research Excellence (Afrique One-ASPIRE), a six-year initiative which closed in June 2022, supported graduate training and research on rabies, brucellosis, mycobacterial infections, foodborne disease, and surveillance and response in 12 countries with seven core African institutions.
- Bilateral investments support research and implementation in multiple African nations, in line with a One Health approach, particularly through U.S., UK, France, Finland, Sweden, Germany, and Norway, among others (e.g. Preventing Zoonotic Disease Emergence (PREZODE), USAID's Emerging Pandemic Threats program (e.g. PREDICT, Preparedness & Response, Breakthrough Action, and Human resources for Health 2030 projects), and the Fleming Fund's AMR projects).
- The World Bank supports human and animal health investments in the continent, among them: the Regional Disease Surveillance Systems Enhancement (REDISSE) program (with 16 countries, including 11 in West Africa and an expansion to Central Africa in its fourth phase), which has helped to strengthen core infrastructure, emergency response functions, and One Health coordination; the Eastern and Southern Africa One Health Regional Initiative launched in 2022; and the Regional Integrated Surveillance and Laboratory Network (RISLNET) in collaboration with the Africa CDC.

Approach

This report examines the state of veterinary and One Health systems in Africa. Several important scans of One Health initiatives in the continent have been conducted previously (e.g., Fasina et al. 2020),¹ which provide valuable insight on the scope of efforts, including key topics and partners, as well as indications of where One Health activity is especially robust. Additionally, several recent programs have been launched in the continent, some across multiple countries. This report sought to complement these existing efforts by examining systems-level coverage, needs, and opportunities, primarily with national governments and regional institutions in mind.

METHODS

Information was synthesized from publicly-available data, scientific and grey literature reviews, virtual workshops and consultations with experts from target countries and regions, and where possible given the constraints of the COVID-19 pandemic, in-person consultations. Participation in webinars and conferences between 2021 and 2022 provided additional insight. Information gathering, validation, and refinement was an iterative process, with several stages of revision and refinement. Information was compiled between October 2020 through August 2022.

Database. To examine continental, regional, and national trends in globally-available data, a database was developed with indicators from the public health, animal health, and environmental sectors. Country-level data were obtained from over 30 publicly available datasets, most of which come from international agencies. Data from 2010-2019 was included. A descriptive data analysis was conducted. The compiled database can be accessed at: <https://github.com/ecohealthalliance/One-Health-Database-Africa>. A subset of data is captured in the Country Dashboards, which provide a snapshot from a selection of indicators

grouped by Assessments and Plans, Workforce, Demographic Factors, Environmental and Sanitation Factors, and Animal Factors. These are intended to provide quick orientation and context on potential sources of risk, vulnerabilities, and current capacity to support interpretation of Country Reports. Please see Table on the next page for an overview of indicators and data sources. Country data was benchmarked against regional and continental data. To reduce the potential for data anomalies during a pandemic period, and to account for time lags in the availability of annual statistics data, 2019 was used as the reference year (where not available, the most recent available year was used). The data sets utilized in this report mainly come from data officially reported by governments to international agencies, and are generally considered the international standard. However, these are still subject to reporting flaws. In select cases data was flagged by experts as erroneous; these are reflected in some country discussions. It should be noted that there was high year-to-year variation for some indicators (number of veterinarians, for example), which may indicate differences in how information is calculated (for example, all registered versus actively practicing veterinarians).

Regional and country reports. To complement officially reported data, regional reports are presented, following the United Nations regional classifications. These are accompanied by 11 country reports (Botswana, Cameroon, Côte d'Ivoire, Djibouti, Ethiopia, Ghana, Kenya, Mali, Morocco, Senegal, and South Africa) intended to capture variation in contexts, particularly in governance systems, economic development, infrastructure, industries, environmental and social conditions, epidemic and endemic diseases, and vulnerabilities and threats. However, information gathering was conducted more widely, and thus the key assumptions and conclusions reflect a continental perspective.

For the purpose of readability, country names follow their short form; no endorsement of nomenclature is implied. Similarly, in using the regional groupings per the UN categories, no specific position on political boundaries is intended.

Country assessment and planning tools. Assessment, prioritization, and action planning mission reports were utilized as inputs to this report. The Joint External Evaluation (JEE) tool assesses country public health capacity, as aligned to the International Health Regulations (IHR). Since its release in 2016, three updates to the tool have been published. Because most available reports had utilized the JEE tool 1st edition, it was used as the benchmark, with indicators from the 2nd edition cross-checked and excluded where not comparable. A 3rd edition was released in 2022, which will affect benchmarking against previous and future JEE reports. The Performance of Veterinary Services (PVS) evaluation tool, now in its 7th edition, assesses country veterinary services capacity, aligned to the WOAHA Aquatic and Terrestrial Animal Health Code. The latest edition features some scope for assessing countries on One Health systems. Both the JEE and PVS are voluntary processes for countries; however, only the JEE carries the expectation for countries to make the findings public. To date, few countries in the continent have made their PVS mission report public (as such, scores from the PVS evaluation tool were not analyzed in this report). It should be noted that the JEE and PVS are not intended for comparison across countries, but to facilitate country-specific prioritization and action. There is no comparable tool for the environment sector, and wildlife has limited inclusion in the JEE and PVS tools.^{2,3}

OVERALL SCOPE

The report touches on several aspects, attempting to broadly capture variation in contexts, as well as reflect how some production systems are evolving and the resulting implications for veterinary and/or One Health systems. It should be acknowledged that regional and country reports largely have a terrestrial bias, and aquatic ecosystems and production systems would warrant a more focused look in the future; however, based on global trends, it can generally be assumed that compared to terrestrial animal health and environments, health systems related to aquatic environments are equally or more limited in capacity and resourcing.

In general, country and regional reports have been condensed down to systems-level information. This was intended to take into account efforts as a whole, including to identify chronic gaps not likely to be solved by on-off projects or external funding. For this reason, initiatives included are not exhaustive; where specific projects are mentioned, is generally to shine light on application in that specific context, explain the relevance, and show the potential for upscaling or broader efforts.

ENDNOTES

- 1 Fasina et al. 2021. The One Health landscape in sub-Saharan African countries. *One Health* 13: 100325.
- 2 World Bank. 2018. Operational Framework for Strengthening Human, Animal and Environmental Public Health Systems at their Interface.
- 3 Machalaba C, Uhart M, Ryser-Degiorgis MP, Karesh WB. 2021. Gaps in health security related to wildlife and environment affecting pandemic prevention and preparedness, 2007-2020. *Bulletin of the World Health Organization* 99(5):342-350.

Table.
Indicators included in country dashboards
(see Annex for indicator definitions and scales).

Indicator	Source(s)	N
Joint External Evaluation (JEE)	WHO	51
Performance of Veterinary Services (PVS) Evaluation	WOAH	N/A
PVS Evaluation Follow-Up	WOAH	N/A
PVS Gap Analysis	WOAH	N/A
PVS Legislation	WOAH	N/A
IHR-PVS National Bridging Workshop	WOAH	N/A
National Action Plan for Health Security (NAPHS)	WHO	N/A
One Health Zoonotic Disease Prioritization Workshop	U.S. CDC	N/A
National AMR Action Plan	WHO	N/A
National Biodiversity Strategy and Action Plan (NBSAP)	CBD	N/A
Multi-sector and One Health collaboration/ coordination for AMR (1-5)	TrACCS	25
Collaborative effort on activities to address zoonoses (0- 100)	WHO SPAR	53
Current health expenditure per capita (current USD)	World Bank	53
Disbursements received from WHO Contingency Fund for Emergencies	WHO	27
Number of veterinarians	WOAH-WAHIS	53
Number of veterinarians (per 1,000 people)	WOAH-WAHIS; World Bank	53
Number of public animal health professionals	WOAH-WAHIS	50
Number of public animal health professionals (per 1,000 people)	WOAH-WAHIS; World Bank	50
Number of medical doctors	WHO	54
Number of medical doctors (per 1,000 people)	WHO; World Bank	54
Up-to-date multisectoral workforce strategy (1-5)	WHO JEE	51
Progress with strengthening veterinary services (1-5)	TrACCS	25
Population - total	World Bank	54
Population - percent change (2010-2019)	World Bank	54
GNI per capita (current USD)	World Bank	54
Land area (sq. km)	World Bank	54
Arable land (% of land area)	World Bank	53
Forest area (% of land area)	World Bank	54
Terrestrial protected areas (% of land area)	World Bank	54
Average primary forest loss (ha)	Global Forest Watch	31
Access to basic drinking water (rural)	UNICEF/WHO	50
Access to basic drinking water (national)	UNICEF/WHO	52
Access to basic hygiene (national)	UNICEF/WHO	38
Access to basic sanitation (national)	UNICEF/WHO	50
Average livestock imports (as livestock units, LSUs)	FAOSTAT	54
Average livestock exports (as livestock units, LSUs)	FAOSTAT	54
Average livestock stocks (as livestock units, LSUs)	FAOSTAT	54
Number of mammal species	IUCN	54

*N/A is used for indicators reflecting whether a country did or did not complete the assessment, exercise, or plan, rather than a reported value by countries or other entities.

Continental Look

ONE HEALTH SUMMARY INDICATORS

COUNTRIES REFLECTED: Botswana, Cameroon (some fields missing), Côte d'Ivoire, Djibouti, Ethiopia, Ghana, Kenya, Mali, Morocco, Senegal, South Africa.

	INDICATOR	NUMBER OF COUNTRIES	COUNTRIES SHOWING EVIDENCE OF INDICATOR
Multi-sectoral coordination mechanisms	National One Health coordination platform in existence	9/11	Botswana, Cameroon, Côte d'Ivoire, Ethiopia, Ghana, Kenya, Mali, Senegal, South Africa
	National One Health coordination platform has designated financial/human resources	2/11 ⚠	Côte d'Ivoire, Senegal
	National One Health coordination platform has mandate and resources to implement policies and programs	4/11 ⚠	Cameroon, Côte d'Ivoire, Mali, Senegal
Financial Resources	Budget dedicated for wildlife disease systems	3/11 ⚠	Ethiopia, Kenya, South Africa
	Financial resources for One Health activities equitably allocated across sectors	0/11 ⚠	
	Most One Health activities are sustained by domestic funding	1/11 ⚠	Botswana
	External funding for One Health activities is aligned with existing national priorities	5/11 ⚠	Côte d'Ivoire, Ethiopia, Mali, Senegal, South Africa
Workforce	Wildlife veterinarian(s) are employed in the public service (state or para-statal)	8/10	Botswana, Ethiopia, Ghana, Morocco, Kenya, Mali, Senegal, South Africa
	Community animal health workers are trained on One Health approaches	5/10 ⚠	Botswana, Côte d'Ivoire, Kenya, Morocco, Senegal
	Animal health professionals are engaged in FELTP	9/11	Cameroon, Côte d'Ivoire, Djibouti, Ethiopia, Ghana, Kenya, Mali, Senegal, South Africa
	Environmental professionals are engaged in FELTP	7/10	Cameroon, Côte d'Ivoire, Ethiopia, Ghana, Kenya, Mali, Senegal
	Surveillance and reporting system in place for disease events in wildlife	8/11	Botswana, Djibouti, Ethiopia, Ghana, Kenya, Mali, Morocco, South Africa
	Availability of laboratory services to test for novel pathogens in country	9/10	Botswana, Côte d'Ivoire, Ethiopia, Ghana, Kenya, Mali, Morocco, Senegal, South Africa
	Availability of laboratory services to test for toxins in humans, livestock, and wildlife	7/10	Côte d'Ivoire, Ethiopia, Ghana, Kenya, Mali, Morocco, Senegal, South Africa
	Zoonotic or animal disease vaccine production in country	9/11	Botswana, Cameroon, Ethiopia, Ghana, Kenya, Mali, Morocco, Senegal, South Africa

PERSPECTIVES

Perspectives are from ≥ 1 country(ies) to shed light on nuances of the indicators. They are not necessarily reflective of the situation for all assessed countries.

National One Health coordination platform in existence

- Various stages of development, and different levels of activity.
- Non-governmental entities (e.g., One Health associations) play/have played a role.

National One Health coordination platform has designated financial/human resources

- The platform uses human resources already assigned to other portfolios and are therefore not dedicated to OH activities alone
- Each sector is taking charge of its own sub-sectoral activities; most often under the cover of projects.
- Ad hoc committee.
- No dedicated budget lines exist from the national treasury

National One Health coordination platform has mandate and resources to implement policies and programs

- Mandate in place, but resources are limited. They mainly rely on donor support.
- Most resources are external (e.g. World Bank).

Budget dedicated for wildlife disease systems

- Budget is allocated for government-owned wildlife entities, but most wildlife entities are privately owned.
- Parastatal entity has its own budget.
- Overall animal health budget is insufficient, and focused mainly on domestic animals.

Financial resources for One Health activities equitably allocated across sectors

- Since the State has not yet allocated financial resources, the sources from the projects are distributed according to the priorities related to the sectoral activities.
- Under-funding of animal health: for example, very low epidemiology training of veterinarians (~40) and environmental workers (<12) relative to human health workers (hundreds).

Most One Health activities are sustained by domestic funding

- Activities are financed by technical and financial partners.
- No budget line.

External funding for One Health activities is aligned with existing national priorities

- Priorities are defined in the [One Health] governance manual.
- Funding is aligned with donor interests; sometimes interests align with national priorities.

Wildlife veterinarian(s) are employed in the public service (state or para-statal)

- Department of Wildlife and National Parks and Veterinary Services.
- Employed in a parastatal entity.

Community animal health workers are trained on One Health approaches

- Approach is not standardized (e.g., veterinarians are trained but technicians are not.)
- Just starting to happen through the initiatives of some NGOs.
- Only in a few districts.

Animal health professionals are engaged in FELTP

- Only veterinarians are engaged.
- Need more animal health professions to be trained.

Environmental professionals are engaged in FELTP

- 6 agents trained in one country.
- Representative environmental sub-sector not yet determined/identified.

Surveillance and reporting system in place for disease events in wildlife

- The private sector only reports on controlled and notifiable diseases.
- Wildlife diseases are reported by veterinary services to WOA. H.
- Most focus is on domestic animals, but some wildlife activities (e.g. migratory birds) on HPAI.

Availability of laboratory services to test for novel pathogens in country

- Pursued with the help of international reference laboratories.
- Sequencing facilities are available.

Availability of laboratory services to test for toxins in humans, livestock, and wildlife

- Mainly in the private sector.
- For livestock, no accredited laboratory for toxicology.

Zoonotic or animal disease vaccine production in country

- A range of vaccines are produced (including >20 types in one country's National Veterinary Institute).
- Rabies vaccine production halted.
- Very capable of production if technology is available and patent issues are sorted.

KEY STATISTICS



LABORATORIES

BSL-4 laboratories

two for ~1.3 billion people



EXPENDITURE

Health expenditure per person

Median: \$59 (Range: \$20-\$840)
68% (36 of 53 reporting) spend below \$100



ECONOMIES

GDP from agriculture, forestry and fishing

23 countries with >20% of GDP



WORKFORCE PER 1,000 PEOPLE

0.40 **physicians**
0.17 **veterinarians**
0.02 **animal health professionals**
in public sector



SANITATION

Access to sanitation

Range: 7-96% (Median: 36%)



LAND CONSERVATION

Terrestrial Protected Areas

Average: 16% (Range: 0.21 - 49%)



ELECTRICITY

Access to electricity

Range: 7-100%
27 countries (of 54) with <50% access



DRINKING WATER: RURAL

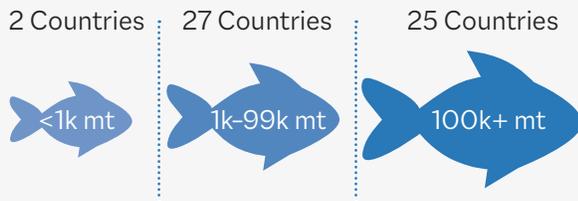
At least basic drinking water services

Average: 55.48% of population

FISH PRODUCTION

Average capture fisheries production (metric tons)

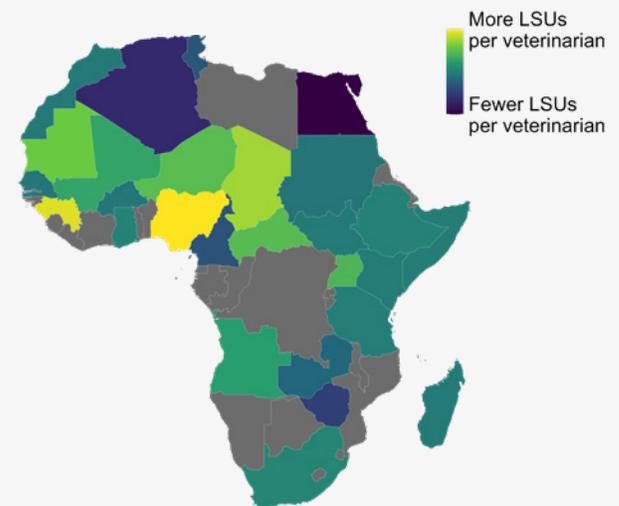
Range: 50 - 1,288,686 mt



Only 4 countries with PVS Aquatic missions

LIVESTOCK PRODUCTION

Livestock Units produced to veterinarian ratio



WILDLIFE DISEASE REPORTING



Chemical Poisoning

588 incidents (>20,000 animals)
reported to the Africa Wildlife Poison
Database (as of 2021)

These metrics are not intended as critiques; but reinforce chronic gaps and the diverse scope of topics that require strategies for domestic financing, workforce development, and partnerships.

CONTINENTAL CASE STUDY:

Rabies

Rabies is endemic across the African continent, where an estimated 20,000-25,000 deaths still occur from the disease each year, primarily in children. At national and regional levels, rabies is recognized as a priority zoonotic disease, and there is generally a high perception of rabies prevention and control as requiring One Health collaboration in the continent. However, despite the availability of proven tools to fight rabies, chronic implementation gaps are widespread, indicative of broader system challenges. Country commitments to rabies elimination by 2030 — a global target not reflective of country baseline capacity — signal willingness; achieving and sustaining this goal will require substantial system strengthening, ideally in ways that address zoonotic and animal disease threats as a whole.

GENERAL STATUS

Countries in the continent currently undertake a variety of different prevention and control strategies, with differing intensity and evolving situations. Several countries at one point had robust mass dog vaccination (MDV) systems (e.g., Ghana, Liberia) that were dismantled several decades ago during conflict-related instability. Today, many campaigns are sporadic, relying on external support for vaccines and undertaking short-term vaccination efforts (i.e., during World Rabies Day celebrations) that do not near the ~70% coverage needed to interrupt transmission of canine rabies. In some countries, such as Djibouti and South Africa, vaccination of pets is compulsory. However, across most countries, a major urban-rural divide is evident, with veterinary services increasingly concentrated in urban areas (often in private practice) and poor access to canine vaccination and post-exposure prophylaxis (PEP) in rural settings.

MONITORING

In general, countries monitor the movement of domestic animals at formal borders (particularly airports) to prevent rabies introduction. However,

porous land and sea borders allow for regular movement of wild and domestic animals; the lack of coherence in rabies prevention and control strategies between countries can therefore undermine success of efforts. Because of limited sequencing capabilities, circulating strains and potentially their transmission cycles are poorly documented.

Dog Management

Dogs are the prevailing source of human rabies (contributing to an estimated 99% of cases in the continent). The lack of dog census data is an impediment to planning of MDV campaigns, for number of vaccines but also allocation of campaigns (vaccinators, transport). Dog ownership views, purposes (e.g., security, pets, food) and practices vary widely, even within some communities. Stray dog poisoning campaigns are undertaken in a number of countries, both government- and individual-led. These can have effects on non-target animals and contribute to environmental degradation.

Livestock Management

Impacts on livestock are poorly documented; however, farmer interests are reported to affect uptake of

Rabies

response measures that are common in response to signs of rabies in dogs. As with other communicable diseases, compensation for losses may play a role in incentivizing reporting and risk reduction.

Wildlife Management

Outbreaks of rabies have been observed in wildlife, linked to serious declines in two endangered carnivore species (the Ethiopian wolf and African wild dog). Conservation efforts have helped to implement oral baiting and injection vaccines to reduce disease spread. However, responses to rabies in wildlife tend to be ad hoc; in particular, there is no African body specifically tasked with protecting the health of wildlife. Wildlife outbreaks of rabies are often introduced via domestic animals (for example, encroachment into protected areas), though some strains have evolved to be independently maintained. These play a negligible role in human disease burden in Africa.

Human rabies PEP

According to the U.S. CDC's annual assessment of country rabies status, timely availability to human rabies vaccine (access within 48 hours of a patient presenting for care throughout most of the country) is extremely limited: Human rabies vaccine was only available in 7 countries, whereas rabies immune globulin (RIG) PEP was only available in 5. PEP is provided through some national health services, but subject to supply chain issues or shutdowns of government-staffed clinics. Corruption issues with stolen doses resold for profit are public knowledge in some countries. The private cost of PEP (an average of \$40 in the continent as estimated by the WHO) is cost-prohibitive for many, making the difference of life or death an access issue.

CURRENT EFFORTS

At continental level, AU-IBAR has conducted a recent baseline survey to identify country needs. The Pan-African Rabies Control Network (PARACON), under the secretariat of the Global Alliance for Rabies Control (GARC) and its Blueprint for Canine Rabies Prevention and Control, was established to provide Africa-focused advice and networking toward rabies control and elimination. The Network, which held its first meeting in 2015 in South Africa, brings together countries in Sub-Saharan Africa (Northern Africa is part of the Middle East and Eastern Europe Rabies Expert Group). Burundi, Djibouti, Equatorial Guinea, Eritrea, Mauritania, and Somalia have not yet participated in Network meetings. Regional initiatives such as Rabies in West Africa (RIWA) are also helping to facilitate coordination and benchmarking, including through use of the Stepwise Approach towards Rabies Elimination (SARE) assessment tool.

Countries have integrated dog bites and human rabies cases into their IDSR weekly epi-surveillance bulletin, though cases are widely considered under-reported. Under PARACON, the rabies disease surveillance bulletin has been developed to support national reporting and international reporting obligations to WHO, WOAHA and FAO; to date this system has been used by 23 countries in the continent. In addition, FAO and WOAHA are supporting countries on detection and confirmatory testing processes in veterinary laboratories and investigation of animal cases. The limited availability of reagents, as well as sample movement for testing (particularly from rural areas), remain day-to-day barriers.

One Health partnerships are also being formed to support action from multiple angles. An IHR-PVS National Bridging Workshop on Rabies was held in August 2022 with support from WHO, convening health services, veterinary services, and other relevant ministries and departments (wildlife, disaster management) in Ghana to support multisectoral

alignment and joint plans. In Ethiopia, animal and human rabies vaccines are now being produced by the country's respective veterinary and public health institutes. The African Network for Animal Welfare, conservation organizations, and social science groups are also contributing to rabies efforts across the continent. For example, risk communication and community engagement using radio shows or visual tools, especially for school children or adolescents at highest risk of bite exposures, is encouraging safe risk reduction and response practices.

The role of community animal health workers (CAHWs) is also increasingly recognized as a major asset for rabies detection, reporting, and prevention. Investing in this workforce appears to be helping to fill an important gap where veterinary services are not available. However, the scope of their role is not standardized, including in regard to training on One Health or rabies standard operating procedures. Other examples of subnational efforts include launching an action plan in 2 high-risk Kenyan counties, and establishment of 30 anti-rabies centers in Côte d'Ivoire, mainly in the country's interior.

KEY IMPLEMENTATION GAPS

- Poor coherence in strategies taken across countries and sectors, or lack of a strategy
- Lack of domestic financing for mass dog vaccination, relying on external resources
- Sporadic campaigns not reaching necessary geographic or population coverage
- Lack of local canine rabies vaccine and PEP production and poor traceability
- Sample transport and testing gaps, including supply of reagents
- Poor underlying epidemiological data to inform design of prevention and control plans

KEY RECOMMENDATIONS

- Undertake the SARE assessment and implement the Canine Rabies Blueprint
- Encourage continuous system improvement for practical One Health action, supported through National Bridging Workshops, simulation exercises, and after-action reviews
- Develop national strategies, with a plan for sustained (ideally domestic) financing given the 7-10 year time horizon typically required for elimination
- Participate in relevant regional networks for knowledge exchange and coordination
- Appoint a rabies focal point to liaise across sectors, serve in regional networks, link with available implementation resources, and leverage other initiatives that reach rural populations (e.g. polio or PPR campaigns etc.) to support implementation efforts
- Review and modernize/strengthen regulations to reduce relevant sources of risk (via vaccination requirements, avoiding wildlife-domestic animal contact, strengthening border policies, compensating for production losses) and welfare considerations
- Strengthen epidemiological surveillance and reporting in humans and animals
- Align research efforts with applied needs (e.g. dog census data)
- Address gaps in laboratory system functionality, including the regional production of reagents, skilled workforce, and quality assurance services
- Formalize role and standardize training of community animal health workers
- Enhance supply chain management and traceability for PEP and vaccines, potentially leveraging systems

CONTINENTAL CASE STUDY:

Rabies

for anti-counterfeit medicines, and increasing rural access

- Decentralize sensitization campaigns to improve awareness and uptake of safe practices in rural populations and youth, such as through school clubs
- Support frequent coordination and information sharing between human, domestic animal and wildlife authorities at all levels, particularly through One Health platforms
- Improve awareness and uptake of bite management protocols by clinicians
- Redirect external efforts to contribute to sustained programs (e.g. train-the-trainer)

Many campaigns are sporadic, relying on external support for vaccines and undertaking short-term vaccination efforts...that do not near the ~70% coverage needed to interrupt transmission of canine rabies.

CONTINENTAL CASE STUDY:

Monkeypox

The monkeypox virus (MPXV) is currently the most prevalent human Orthopoxvirus and has been re-emerging since the eradication of smallpox in 1980. Unlike smallpox, human monkeypox is a zoonotic disease that persists in a poorly characterized mammal reservoir(s), making it unlikely to eradicate. Until declared a global health emergency by WHO in 2022, the disease was considered an African viral zoonotic endemic disease that remained restricted to the tropical lowland rainforests of Central and West Africa, with 25,000 cases officially notified to WHO since its discovery, and with 96% occurring in the Democratic Republic of the Congo (DRC). The case fatality ratio of monkeypox has ranged from 3–6% in the last two decades in the general African population, and is higher among young children.

GENERAL STATUS

Human monkeypox was first described in 1970 in DRC. From 1980 onwards, sporadic human cases have been continuously increasing in Africa with >5,000 suspected cases per year. In humans, index cases get infected through contact with infected animals during farming, hunting, wild meat preparation activities (e.g. butchering), or eating undercooked bushmeat. Human-to-human transmission (secondary cases) occurs by respiratory droplets or by close contact with infected lesions or bodily fluids. The virus infects non-human primates including great apes where it causes disease similar to humans.

Prior to 2022, Monkeypox had occurred in 10 African countries. Cases have been increasing in travelers returning from African countries (culminating in 2022 in an unprecedented multi-country outbreak). Countries in the continent currently undertake a variety of surveillance and prevention strategies with differing efforts depending on the occurrence of confirmed human cases in the country (e.g. DRC included it in its Integrated Disease Surveillance and Response (IDSR) in 2022) or proven threats to great apes (e.g. Côte d'Ivoire, Cameroon). DRC, through various

collaborations, has been leading most breakthrough research (including vaccine clinical trials), case control studies and examination of wildlife reservoirs and behavioral risk factors. Outside of clinical trials, monkeypox vaccination is generally not available to healthcare providers or other populations in endemic countries in Africa.

MONKEYPOX VIRAL DIVERSITY

Clade II (formerly called the West African or WA-strain) causes milder symptoms and previously no inter-human transmission was documented as compared to clade I (formerly known as the Congo-Basin or CB-strain). Whether the subtle genetic differences between the clades have translated into distinct animal reservoirs bears further investigation but the virus seem to infect a wide range of mammals with no known or documented symptoms. This has several epidemiological consequences that we are experiencing today: the introduction of clade II in naïve populations is leading to more controllable epidemics than would be the case for an introduction of clade I viruses.

Monkeypox

MONITORING

In general, countries rely on passive surveillance of human monkeypox and no country has systematic wildlife surveillance in place. Only DRC implemented transiently (2 years) active surveillance after the 1996 outbreak with 600 cases, during which squirrels were suspected to be the wildlife reservoir and zoonotic source. Standard laboratory diagnosis and genomics guidelines and RT-PCR kits for the African region have been recommended for human cases by WHO but are rarely available in remote areas where monkeypox more often emerges. As a result, the robustness of field surveillance is currently based on clinical suspicion and symptoms (and the field differential diagnosis between monkeypox and chickenpox is particularly challenging). It is generally accepted that monkeypox is underreported across the continent.

RESERVOIRS

The origin, and historical and present distribution of the MPXV remains to be solved and the identity of the natural reservoir(s) requires further research. In 2003, the disease was introduced in the USA via a shipment of rodents from Ghana - a country that had never previously reported any human cases. African squirrels that inhabit forested areas around rural villages were the first to be pinpointed as candidate reservoirs. Studies suggest that a wider variety of mammals (musk shrews, target rat, Gambian pouched rats, African dormice) may be asymptomatic carriers.

CURRENT EFFORTS

WHO AFRO is providing support to improve surveillance and laboratory capacity, including genomic surveillance in affected countries. Africa CDC has continued to monitor the situation of Monkeypox on the continent and supports the African Union in their efforts to strengthen country surveillance systems and

across borders. Understanding which clade circulates in a given geographical region is thus paramount to controlling future outbreaks and identifying the reservoir and species that contribute to spillovers. Several intergovernmental partners (WHO, WOAHA and FAO) and international academic consortia funded by external donors (EU, USAID, AFD) are currently working in Central and West Africa to address key research and implementation gaps. In Cameroon, a One Health investigation team was mobilized for an outbreak in chimpanzees, aimed at preventing spread to other chimpanzees and humans.

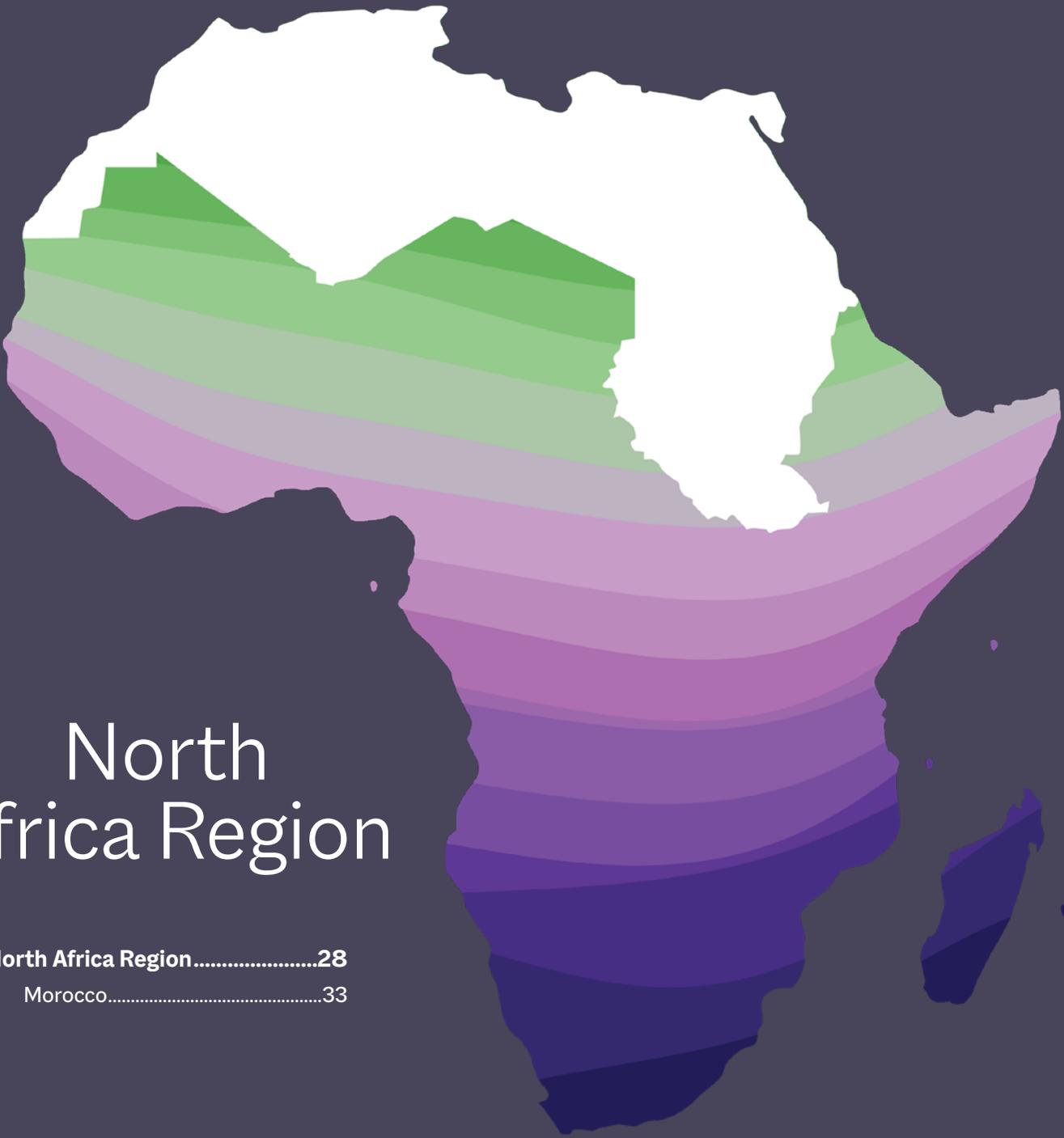
KEY IMPLEMENTATION GAPS

- Lack of systematic passive surveillance in most countries
- Lack of proper One Health outbreak investigations, concomitant with human teams preventing the identification of the zoonotic source and specific risk factors
- Secondary bacterial infection of lesions results in use of antibiotics, increasing AMR risk
- Reliance on sporadic and uncoordinated external resources for Orthopoxvirus and MPXV wildlife reservoir research
- Lack of education and awareness campaigns on the disease, symptoms, transmission and patient care
- Sample transport and testing gaps, including supply of reagents to differentiate from human chickenpox
- Poor underlying epidemiological data to inform design of prevention and control plans

KEY RECOMMENDATIONS

- Encourage “One Health” intervention teams for investigation, response, and risk reduction protocols
- Intensify efforts to identify the reservoirs and routes of transmission (cohort of hunters, wildlife surveillance)
- Implement systematic sample testing and strain typing to monitor mutations and map the distribution of Clade I and Clade II from human and wildlife samples
- Involve Veterinary Services laboratories in capacity development training on the diagnosis of monkey pox disease, and intensify monkeypox surveillance in Africa among human and animal populations
- Coordinate transborder surveillance
- Provide vaccination to health workers and provide oral treatment (e.g. Tecovirimax)
- Develop an easy-to-use thermostable point of care rapid diagnostic tests able to differentiate between Monkeypox, other Orthopoxviruses, and Chickenpox
- Improve patient care and institute proper SOPs for the care of clinical skin lesions
- Strengthen country or region capacity for systematic sample testing and strain typing
- Sensitize and improve prevention via outreach campaigns in at-risk areas

Regional and Country Reports



North Africa Region

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North Africa Region

CONTEXT

The North Africa region is defined by the United Nations as Algeria, Egypt, Libya, Morocco, Sudan, Tunisia, and Western Sahara. Most of the countries are affiliated with the Middle East and Northern Africa (MENA) regional grouping (sometimes with Sudan included), and overlaps with the Sahel and parts of Central and West Africa (e.g. Mauritania); for this reason, several countries falling in other regional groupings are also discussed here as relevant. Its wide expanse from the Atlantic ocean, Mediterranean Sea and Red Sea also provides it with important coastal ecosystems.

The region faces volatility, with recent political unrest and conflict along border areas.¹ Reliance on rainfall is an important determinant of the distribution of permanent settlements and nomadic pastoralist movements. The effects from climate change create new vulnerabilities; for example, an estimated \$879 million is needed for climate adaptation for agriculture and livestock sectors in Mauritania.²

The region has experienced outbreaks such as Rift Valley Fever and West Nile virus, ongoing transmission of rabies, as well as cutaneous leishmaniasis and shistosomiasis (both exacerbated by irrigation practices) and tick-borne Mediterranean spotted fever. A 2018 outbreak of cholera in Algeria — its first after a 20-year lack of cholera epidemics — was likely imported via South Asia.³

Livestock contribution to agricultural GDP is substantial in the region. Morocco and Algeria have large rangelands areas with pastoral communities, particularly across their savannah ecosystems. Egypt and Libya and Mauritania are mostly desert countries

with minimal rangelands.⁴ Tunisia has a high urban population. In the Maghreb (Morocco, Algeria, Tunisia, and Libya), the Atlas mountains and high plateaus are used for agro-pastoralism production systems.

CURRENT SITUATION

Regional coordination and governance initiatives

Countries in the region form part of several economic communities, including the Community of Sahel-Saharan States CEN-SAD, based in Tripoli, Libya, and the Arab Maghreb Union (UMA), a Regional Intergovernmental Union of the five Maghreb Countries in Northern Africa. Several countries in the region are part of the WHO's Regional Office for Eastern Mediterranean (EMRO).

A Regional Working Group with the UN Integrated Strategy for the Sahel (UNISS) maximize synergies with the Office of the Special Coordinator for Development in the Sahel.

The Animal Health Strategy for Africa 2018-2035 is a continental framework for delivering a sustainable animal health system as part of the One Health approach. It is aligned with the Animal Development Strategy for Africa (LiDeSA) that is working towards the harmonization of animal health services in Africa and with the relevant global, continental and regional strategies and frameworks.

Regional diseases of concern and relevant risk management measures

Transborder movement of livestock and people, particularly along the Sahel, is common. In North Africa, several tickborne diseases of humans and livestock have been detected (e.g. Crimean Congo hemorrhagic

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S

STRENGTHS

Transboundary animal diseases and risk factors for their spread have been clearly identified in the region

Veterinary and field epidemiology training programs and pipelines well established

Outbreaks in animal populations centralized serving as early warning systems for the region

Animal health networks in the region enable disease information sharing

W

WEAKNESSES

Porous border crossings, with limited preparedness and protection capacities

No One Health regional mechanism in place

O

OPPORTUNITIES

Multiple regional union and communities and the African Union collaboration providing a framework to deal with regional issues for territorial and health security

Interest in regional One Health platform

T

THREATS

Migration, transhumance, animal trade, and livestock production are all poorly controlled in unstable areas

Climate shocks, e.g. drought

Conflict and instability

Reliability on external donor funding for emerging disease preparedness and prevention activities threatens sustainability

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fever, theileriosis, babesiosis).⁵ For livestock, key diseases include, contagious bovine pleuropneumonia (CBPP), peste des petits ruminants (PPR) and Rift Valley fever (RVF), rinderpest, African swine fever because of the cross-border risk posed by trade in pig meat products, and anthrax, as well as highly pathogenic avian influenza in poultry (particularly in Egypt). After over a decade without cases in Algeria, Morocco and Tunisia, in recent years several FMD introductions have occurred in these and other North African countries. The three countries started working together in 2011 to coordinate plans to tackle FMD. However, the uncontrolled livestock movement at border crossings presents a challenge for control, and unrest in Libya has contributed to disrupted vaccination and planning strategies. To enhance preparedness, several countries have developed immediate vaccine procurement plans (and funding mechanisms) in the event of FMD cases.⁶

The movement of live cattle and small ruminants flows through the Sahel to coastal countries and is a source of disease introduction risk. Western Sahel region countries are connected through Mauritania entry points.⁷ The mobility of farmers and their herds has the double potential effect of exposing healthy animals to new pathogenic agents upon their arrival or introducing infected animals into disease-free areas, thus putting at risk origin and destination countries.

Canine rabies remains a challenge for the region. There are subnational challenges regarding stray dog population management and access to sufficient volumes of vaccine; dog culling is undertaken by some authorities.

REGIONAL PREVENTION AND CONTROL MEASURES

Through the World Bank, the International Development Association (IDA)-financed Regional Sahel Pastoralism Support Project (PRAPS) supported livestock assests in Sahelian countries: Burkina Faso,

Chad, Mali, Mauritania, Niger, and Senegal (see West Africa report too). The scope was focused on pastoral system resource management, herd animal health, access to markets, alternative income generating activities, and conflict management.⁸

In 2009, 10 Western Mediterranean countries created the Mediterranean Animal Health Network (REseau MEditerranéen de Santé Animale – REMESA) to optimize the capacities of their animal health regional programs and share technical assistance. To support flow of epidemiological information under REMESA, the regional Veterinary Epidemio-surveillance Network (REPIVET) later followed,⁹ to provide a space for national epidemiologists and experts to exchange on animal disease prevention and control, including for alerts of importance for points of entry. REPIVET activities are supported by FAO-ECTAD Unit for North Africa and WOAHA under the Regional Animal Health Centre for North Africa with the Arab Maghreb Union and European Union. The network develops its activities in close collaboration with the Animal Health Laboratories Network (RELABSA).

A biosecurity network initiative — the G5 Sahel Biosecurity project — aiming at better responding to biological threats and health crises launched in 2016 through GIZ, the Mérieux Foundation and the Bundeswehr Institute of Microbiology.¹⁰ The project has been developing a multicountry network of mobile laboratories in the G5 Sahel countries: Burkina Faso, Chad, Mali, Mauritania, and Niger.

The Great Green Wall was launched in 2007 with leadership from the African Union.¹¹ It was originally a regional initiative to address land degradation, signed by 11 intervention countries with a goal to stop desert progression and regreen a tree belt between both coasts of Africa across the Sahelian region. It has transformed into a Pan-African movement with more than 20 countries involved, including Algeria, Egypt, Libya, and Tunisia now partners.

The FAO and WOAHA Sub Regional Representation for North Africa have been established to cover the five

Box.
Externally supported One Health activities in the region

The EU-funded OH-NEXTGEN (Training of the One Health next scientific generation in the Sahel and Maghreb) project was implemented between 2011-2015 with a focus on a new generation of scientists in disease control in using a One Health approach.

Mediterranean Animal Health Network (REMESA): Since 2015, the WOAHA Sub-Regional Representation for North Africa organized several workshops on epidemiology and surveillance of animal diseases via REMESA to improve knowledge on animal health disease surveillance in the North Africa region and part of Middle East, and begin dialogue on cross-cutting socio-economic elements. Under the 'Strengthening Veterinary Services in Developing Countries' project funded by the European Union, Algeria, Morocco and Tunisia have been part of a rabies-focused component (SVSDC+R). In Tunisia, this component has helped to mobilize more than 800,000 doses of canine rabies vaccine and develop a Municipal Centre for stray dog sterilization and vaccination following trainings on stray dog management.

The Institute Pasteur Network is well anchored in the region especially in Maghreb countries. The Mohammed VI Polytechnic University (UM6P) and the Pasteur Institute of Morocco (IPM) recently signed an agreement to improve Morocco's capacity for virology research, which will enable a new medical virology center for highly pathogenic agents and support new diagnostic techniques.

Mobile Laboratories: The Moroccan Ministry of Health has provided mobile laboratories that perform COVID-19 tests for the country's remote areas. A partnership with Abu Dhabi's G42 Healthcare and the South Korean biotechnology company Seegene is supporting high-throughput molecular mobile laboratory stations in the MENA region, including five countries in Northern Africa using a multiplex testing platform that can accommodate 225 pathogens over its different panels.

member countries of the WOAHA in the region (Algeria, Libya, Morocco, Mauritania, Tunisia) and works together with the Arab Maghreb Union representation (UMA) based in Morocco. Egypt is also associated with certain activities in connection with the global framework for the progressive control of animal diseases (GF-TADs), the RAHCs, and REMESA.

Several prevention and control measures are ad-hoc projects supported and/or implemented by external partners (Box on One Health activities). These projects are often focused on developing laboratory or surveillance capacity or research. Egypt maintains WOAHA reference laboratories for avian influenza and

brucellosis. The WOAHA reference laboratory on echinococcus was previously located in Morocco. The Institute Pasteur network is active in the region and has long-term collaboration with the IHU Marseilles and the Maghreb countries for disease detection and research on emerging and other zoonotic diseases.

Regional training pipelines and research collaborations

There are veterinary schools present in Algeria, Egypt, Libya, Morocco, and Tunisia.

Field epidemiology training programs (FETPs) are available in the region, with the Eastern Mediterranean Public Health Network (EMPHNET), which Morocco,

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Tunisia and Egypt are partners in. The FETP Front Line One Health - a module for the Master's degree in Field Epidemiology Training Program - further allows developing the "One Health" concept for more effective action. These are also mobilized for wider benefit; for example, the program in Morocco has also conducted workshops on biorisk management, and topics covered are both infectious and non-infectious (for example, investigations undertaken by FETP in 2019 in countries in the region ranged from acute flaccid paralysis to organophosphate poisoning). In Tunisia, the FETP is housed in the country's National Observatory for New and Emerging Diseases, which tracks zoonotic and vector-borne diseases, as well as activities on livestock disease (e.g. Bluetongue).

At the nexus of agricultural livelihoods and environment, CIRAD is involved in several platforms for research, laboratories and capacity building in the region.¹² The Sahel Alliance was launched in 2017, to advance regional security and sustainable development. In 2018 it was backed by the Ouagadougou Declaration, which was signed by CIRAD, national agricultural research organizations in the Sahel countries, and regional institutions such as the Permanent Interstate Committee for Drought Control in the Sahel, the West and Central African Council for Agricultural Research and Development and the Science Service Center on Climate Change and Adapted Land Use. Vétérinaires Sans Frontières Belgium also provides assistance for animal healthcare and family livestock farming in several Sahelian countries.

REGIONAL PRIORITIES AND COMMITMENTS

Indications of interest and commitment to take on One Health and veterinary programs and systems strengthening

Multisectoral One Health coordination mechanisms, platforms or associations in the region are in place, but at various levels of operationalization, activity, resourcing, and involvement from stakeholders. There is the prospect of a regional One Health platform that would provide needed coordination and harmonization.

Several multi-sectoral initiatives are active in the region. FAO-ECTAD, with the support of USAID and the GHSA promote the adoption of One Health in the region, particularly the Sahel. Relevant activities include: awareness campaigns about emerging infectious disease risk interfaces, One Health FETP frontline trainings, national One Health platform support, joint zoonotic disease investigations, and work on antimicrobial Resistance (AMR).

Opportunities to leverage regional COVID-19 activities

In 2022 the World Bank approved additional funding (US\$23.8 million) toward the Tunisia COVID-19 Response Project, aimed at health system strengthening. FETPs in the region have played a role in supporting government activities related to COVID-19 pandemic response, while also working on broader topics (e.g., infection, prevention and control).

Morocco



Completed Assessments and Plans

JEE	PVS Evaluation	PVS Evaluation Follow-Up	PVS Gap Analysis	PVS Legislation	IHR-PVS Bridging Workshop	NAPHS	OHZDP	National AMR Action Plan	NBSAP
2016	2007	2013	2013	-	2018	-	-	2018	2016

Indicator Country Region Average Continent Average

Coordination and Financing

Multi-sector and One Health collaboration/coordination for AMR (1-5)	4.00	3.25	2.44
Collaborative effort on activities to address zoonoses (0-100)	80.00	80.00	54.23
Current health expenditure per capita (USD)	174.22	193.69	132.25
CFE disbursements (USD)	0.00	1,177,816.00	4,903,032.44

Workforce

Veterinarians (total)	2,658.00	16,338.00	3,512.00
Veterinarians (per 1,000 people)	0.07	0.32	0.17
Public animal health professionals (total)	130.00	2,884.00	461.00
Public animal health professionals (per 1,000 people)	0.00	0.06	0.02
Medical doctors (total)	26,003.00	35,477.00	8,574.00
Medical doctors (per 1,000 people)	0.73	1.14	0.41
Up-to-date multisectoral workforce strategy (1-5)	4.00	2.75	2.19
Progress with strengthening veterinary services (1-5)	4.00	2.75	2.80

Demographic Factors

Population (total)	36,471,766.00	40,199,717.83	24,185,802.76
Population growth (% , 2010-2019)	12.80	16.18	23.73
GNI per capita (USD)	3,200.00	3,648.33	2,525.37

Environmental and Sanitation Factors

Land area (sq km)	446,300.00	1,264,604.12	548,414.71
Arable land (% land area)	16.75	8.55	14.14
Forest area (% land area)	12.84	4.73	27.57
Terrestrial protected areas (% land area)	30.78	10.30	16.27
Average primary forest loss (ha)	—	—	20,326.14
Access to basic drinking water — rural (%)	70.70	80.02	55.48
Access to basic drinking water — national (%)	86.80	89.08	69.76
Access to basic hygiene — national (%)	—	68.90	26.71
Access to basic sanitation — national (%)	88.50	79.56	40.71

Animal Factors

Average livestock stocks (LSUs)	6,709,151.68	8,526,466.35	5,551,123.37
Average livestock exports (LSUs)	4,692.11	62,432.79	33,314.93
Average livestock imports (LSUs)	55,692.44	74,599.46	31,044.50
Mammal species (number)	227.00	219.17	241.65

STATUS OF ONE HEALTH AND VETERINARY SYSTEMS

The Ministry of Agriculture, Maritime Fisheries, Rural Development, Water and Forests (MAPMDREF) is mainly focused on agriculture and fisheries. It houses the National Office of Food Safety (ONSSA) which ensures food safety and hygiene, domestic and wild animal health, regulation and control of veterinary and phytosanitary policy, drugs and pharmaceutical products. The WOAHC focal point for Wildlife is the Director of Natural Resource Management under the responsibility of the Director-General of ONSSA. The Animal Health Directorate within ONSSA has historically focused on livestock, but in recent years it has expanded to include animal diseases. It oversees surveillance of livestock health, early detection, prevention and control of epizootic diseases, and veterinary certification for live animal trade.

The lack of human resources at the public level obliges ONSSA to delegate certain services to mandated health veterinarians such as vaccination campaigns and meat inspection in slaughterhouses. At the sub-national level, ONSSA is represented by ten regional directorates. This includes directorates responsible for control and quality at the border crossings (Tangier, Casablanca, and Agadir) and seven regional analysis and research laboratories (Casablanca, Tangiers, Meknes, Marrakech, Oujda, Agadir, and Laayoune). It also oversees 69 provincial veterinary services headed by ONSSA veterinarians as well as provincial plant protection services.

As of 2020, the prevention and control of communicable animal diseases, including emergency interventions such as for foot and mouth disease, accounted for 80% of ONSSA's total budget; remaining amount is mostly dedicated to natural resources management. The funds are divided between the ONSSA's internal income, which represents 20% of the total budget subsidized by the State. Fifty-six percent of ONSSA's budget for

disease prevention and control, and health security goes to private veterinarians. Private veterinarians need to apply to the ONSSA to be registered in the National Order of Veterinarians and be granted a sanitary mandate. Their payment from the State is based on the number of animals vaccinated in vaccination campaigns and inspections carried out in slaughterhouses.

The National Agency for Water and Forests (ANEF) is responsible for the development of local fisheries, parks, nature reserves, and the regulation of game hunting. The Department of Water and Forests (DEF) develops and implements government policy related to wildlife conservation and natural resources use, sustainable forest and pastoral resources management, including the countering desertification and rural development planning. The High Commission for Water and Forests and the Fight against Desertification has now become a national water and forestry agency and is responsible for the "Forests of Morocco 2020-2030" strategy. The National Agency for Aquaculture Development promotes the aquaculture sector and oversees control of seafood products.

The Ministry of Energy Transition and Sustainable Development develops and implements Morocco's national sustainable development strategy, its policy related to energy, mines and geology, and the follow-up of their implementation and evaluation jointly with the ministerial departments involved.

The Ministry of Public Health and Social Protection oversees the Directorate of Epidemiology and Disease Control. It is responsible for hygiene, environmental health, communicable diseases, and laboratory quality control. Health systems are financed mainly from the public budget. The Ministry of Health provides access to health centers, clinics, diagnostic centers, and public hospitals. As part of the 2021 national budget, the government increased the health sector budget by nearly 2 billion dirhams (\$217 million) to over 20 billion dirhams (\$2.2 billion). The population department manages and finances the national immunization plan for public health as well as vaccine supply, cold chain, and surveillance.

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S

STRENGTHS

Engagement of private veterinarians

In-country production of animal vaccine

Surveillance conducted at key risk interfaces (e.g. border posts, farms, livestock markets, assembly points, watering places, slaughterhouses)

National system of identification by tagging and traceability of animals

Government-supported vaccination campaigns for some priority diseases

Ethics committee for research involving animals

Well organized office (ONSSA) dealing with the prevention and control of communicable animal diseases

Laboratory system and network in place and able to detect a wide range of pathogens and toxins

W

WEAKNESSES

No legally recognized One Health platform

No clear guidance on engaging private veterinarians in surveillance activities

Human resource deficits, particularly in human health and veterinary public sector

Limited animal welfare legislation

No financial resources for One Health activities from the government

Limited OH training opportunities for environment and animal health technicians

Reliance on external reference laboratories for confirmatory diagnostic of novel emerging agents

A limited number of actors invest in One Health activities; investments are in silos

O

OPPORTUNITIES

Existing One Health association that is fairly active, and some multi-sectoral collaboration between government ministries (e.g. AMR, HPAI)

Ongoing discussion on engaging private veterinarians in surveillance activities

Willingness to perform One Health activities by members of the OH association and volunteer investment

Animal vaccine sales and exports to neighboring countries contribute to regional health

Good territorial coverage via ONSSA Regional Epidemiology Observatories and Provincial Epidemiology Cells

T

THREATS

Lack of data on existing human resources to better target gaps

Uncertain sustainability (e.g. no support from international organizations or government provided to One Health association as of yet. Lack of official recognition of the OH association by the government which threatens sustainability)

New laws increasing infrastructure and connection for rural and transhumant population may bring about new risk interfaces

No official OH workforce planning or mapping

OH curricula is absent in majority of universities and institutions

Sponsored early retirement, rural exodus and emigration of qualified staff

One Health Coordination

There is no official One Health platform. A “One Health Morocco” association was created in November 2019 by a multidisciplinary team of experts in human, animal, and environmental health, mostly from academic institutions. Prospects are underway to create a platform backed by the association and all actors involved in the One Health concept. A social media presence (a Facebook page) is dedicated to the association and documented initiatives and events hosted by the association over the past 2 years. The first activity took place in February 2020 with the support of the Royal Academy of Morocco and the Hassan II Academy of Sciences and Techniques. A prospective day was organized by the association in July 2022 and hosted by the Royal Institute for Strategic Studies, on the theme “how to adopt the One Health approach in Morocco”. It was a great success with the officials who attended the event. As of yet, no support has yet been committed to the association by decision-makers, the government, or international organizations, after two years of existence and interventions in the press. The recognition of the Association and the willingness to embrace the One Health approach by the State for an official platform would allow for Morocco to be officially acknowledged and supported by international organizations in operationalizing One Health.

Although there is no formal One Health platform, the Ministries of Agriculture, Health, and Energy launched a multi-sectoral, National Plan for the fight against AMR in 2021 in collaboration with FAO, WHO and WOAHA.

Training Pipelines

Morocco has a veterinary school, the Hassan II Agronomic and Veterinary Institute. The school supplies veterinarians and also conducts scientific research as well as program activities. Broadly, trained workforce and human resources are one of the main

constraints of the Moroccan health system; however, the veterinarian workforce has many private veterinarians who regularly contribute to vaccination and inspection campaigns. There is a general shortage of medical, technical, and nursing staff, and issues related to geographical distribution. The reasons for this shortage are twofold: first, many medical science graduates prefer to work in urban areas, and the opportunity for more attractive salaries and life quality abroad. The human resource shortages are mainly due to the lack of budgetary posts allocated to the civil service. The high cost of civil servants’ salaries from the general budget led the State to offer voluntary retirement in 2005 in exchange for a substantial bonus. The result is that many of the skilled staff who retired under this program have not been replaced, with a loss of institutional knowledge, and there has been no recruitment of new staff with the same skills.

Box: Key academic partners in veterinary capacity strengthening in Morocco

The following organizations are key academic partners in veterinary research and capacity building for One Health:

- Hassan II Agronomic and Veterinary Institute (IAV Hassan II), in partnership with the International Center for Agricultural Research in the Dry Areas (ICARDA)
- Mediterranean Agronomic Institute of Saragossa (IAMZ)
- The EU project Coordination of Agricultural Research In the Mediterranean (ARIMNET)
- Union Maghrébine des Associations Ovines et Caprines (UMAOC)
- Maghreb Union of Cattle Breeders’ Associations (UMAEB)

A One Health course has been introduced during the European project OH-Nextgen. A cohort of juniors veterinarians, biologists, and doctors enrolled in a PhD program at the University Hassan II (IAV) followed this on-line course. The OH concept is taught to veterinary students enrolled in the zoonotic diseases program at IAV, in the form of theoretical courses followed by practical training. No other OH-oriented training is provided in other universities or institutions in Morocco to date, due to a lack of knowledge or information and advantages of the approach.

There is a lack of data on the mapping of human resources and needs in Morocco. This presents an obstacle to planning, and compromises efforts to meet the health care needs of the population.

DISEASE MANAGEMENT

Surveillance and Reporting

The epidemiological surveillance of animal diseases aims either to maintain vigilance with respect to pathogenic agents for which Morocco is free of (e.g. avian influenza, foot and mouth disease (FMD), horse sickness, bovine spongiform encephalopathy), or to monitor the epidemiological situation for endemic

diseases in the country (including blue tongue, sheep pox, tuberculosis, brucellosis, and rabies). As part of a National Animal Disease Epidemiological Surveillance Network (RENESMA), this surveillance is carried out at border posts, animal concentration points such as farms, livestock markets, assembly points, and water points and in slaughterhouses. The field epidemiological data are used to map the geographical distribution of notifiable diseases and track epidemiological indicators to inform prevention and control strategies.

In addition, sero-epidemiological surveys are regularly carried out to monitor the incidence of animal diseases present on the national territory, to assess the efficiency of control programs and to ensure the early detection of emerging or introduced diseases. Thus, public health surveillance has continuously evolved to meet national and international health changing realities. The Ministry of Health has led a restructuring of the surveillance system to facilitate effective monitoring, early warning and rapid response to the various epidemic threats. The restructuring process has gained momentum through establishment of Regional Epidemiology Observatories (ORE) and the Provincial Epidemiology Cells (CPE). These structures were established to improve surveillance, data reporting, and health security activities and support the country's decentralization policy. The OREs and CPEs hold key

Box: Relevant training initiatives in Morocco

FETP: In 2010, the National Institute of Health Administration of Morocco (now the National School of Public Health) and the U.S. CDC/TEPHINET established a FETP course called “Epidemiology in Public Health” in Morocco; a field component was later added to meet the original FETP criteria (2 years training with theory and hands-on practice). After the theory training, participants are required to find training sites within the Ministry of Health structures.

One Health Workforce – Next Generation: Another training of trainers took place under the One Health-Next Generation EU-funded project for Francophone and Anglophone Africa in 2013. The training lasted two months with theoretical courses and practical work. Participants included veterinarians, physicians, biologists, and pharmacists. Ten Moroccan nationals were trained in 2013. The host institution was the Agronomic and Veterinary Institute Hassan II in Rabat, with face to face training in French. The second training in English was given online.

roles in epidemiological surveillance, such as the management, coordination and supervision of all epidemiological activities, the prevention and control of highly pathogenic diseases with epidemic potential and in the development of standard operating protocols and field investigations. In addition to these organizational measures, a strong capacity building component was developed with over 300 staff receiving training in epidemiology, biostatistics, computer software, epidemiological alert systems and GIS for disease mapping based on the collected epidemiological records. Finally, with the restructuring of the epidemiological surveillance system, a new organization of the Regional Health Directorates (DRS) was created in 2011 with a Public Health and Epidemiological Surveillance Service in each DRS tasked with disease prevention and control.

A national system of identification and traceability of ruminants by tagging was implemented in 2015. Farmers and animal owners are asked to report any outbreaks of contagious disease to the veterinary service. Participation of livestock keepers and other livestock stakeholders is motivated by recurrent awareness campaigns by local veterinary services, local authorities, and private veterinarians. Livestock breeders are further incentivized by the compensation received for animals slaughtered following the notification of a disease.

There have been many ongoing discussions about the involvement of private veterinarians in the national animal disease epidemiological surveillance system. Financial mechanisms are in place to enable their participation but are considered inadequate; for example, private veterinarians are not interested in vaccinating dogs against rabies as the vaccine is provided free of charge and compensation is only worth \$1 per vaccinated dog. Private veterinarians are engaged in health surveillance and report any suspected disease deemed contagious in the country

to the local veterinary service on a voluntary basis since their sanitary mandate does not mention that they must carry out unpaid epidemiological surveillance.

The Directorate of Epidemiology and Disease Control is responsible for human disease surveillance based on reports from the regional health directorates.

ONSSA publishes a zoo-sanitary bulletin every month which is distributed by the communication cell to the profession by mailing. The Ministry of Health publishes an epidemiological bulletin on their website for events related to human health.

Access to Diagnostics and Vaccines

Diagnostics

ONSSA has a network of 7 veterinary analysis and research laboratories (LRARV) distributed across the national territory (Casablanca, Marrakech, Fez, Agadir, Tangier, Oujda, and Laayoune). Since 2016, Morocco has had five BSL-3 laboratories. The various ONSSA's regional laboratories supervise the analyses and research in animal health and food safety. The Regional Tangiers Laboratory of Analysis and Research (LRART) carries out diagnostic and serological analysis for animal diseases of economic or sanitary relevance, etiological confirmation for suspected outbreaks, and health inspections for import of traded animals. The Casablanca Laboratory for Analysis and Research (LRARC) carries out analyses at regional and national level and is certified by the European Union (EU) for the diagnosis of equine diseases for export. The Pasteur Institute of Casablanca has a virology laboratory specialized in emerging and highly pathogenic viruses.

The ONSSA has recently invested in veterinary laboratories to increase the capacity for analyzing and controlling food products within the framework of the Moroccan Veterinary Drug Residue Monitoring Plan (VDRMP). This plan forms part of the Morocco Green Plan (Plan Maroc vert) that defines the country's agricultural policy.

Vaccination

In 1993, Morocco joined UNICEF's vaccine independence initiative, aimed at making countries self-sufficient in financing their human vaccine supply. As the role of external funding has evolved over time, different vaccines have been added to the national immunization program. There is a vaccine production laboratory under the Ministry of Agriculture called Biopharma which produces veterinary vaccines intended to fight against endemic diseases in Morocco (e.g. HPAI, PPR, equine diseases). A proportion of vaccines produced are exported to African and Middle Eastern countries based on requests for specific diseases.

PREVENTION AND CONTROL MEASURES

Since 2019, ONSSA has been organizing vaccination campaigns against FMD, PPR, sheep pox, and Clostridium enterotoxemia in ruminants.

The government organizes rabies vaccination campaigns for dogs in rural areas. In January 2020, VETO Junior Enterprise (VJE), an association of veterinary students based at IAV Hassan II, vaccinated

600 dogs. ONSSA funded the cost of the vaccines, while VJE and the Hassan II Agronomic and Veterinary Institute (IAV) covered the operational costs and consumable supplies. The animal rabies vaccine is available from Biopharma and the human rabies vaccine from the Pasteur Institute of Morocco.

Since the outbreak of PPR in 2008, vaccination campaigns with the sheep pox vaccine are administered. The control of Bluetongue has become more voluntary, with limited vaccine coverage reported against recently circulating strains, while vaccination against FMD has become nationally mandatory in 2019.

Several institutions are equipped to analyze suspected cases and a contingency plan exists to prevent transborder importation. Notably the 2016 National Action Plan Against Avian Influenza supports surveillance at borders and in migratory bird wetlands in collaboration with the High Commission for Water and Forests, and reinforcement of biosecurity protocols in poultry farms.

ETHICS

Animal welfare legislation is extremely limited in Morocco; however, there is an ethics committee for research using animals under the Moroccan Association

Box: Initiatives and Projects in Morocco

- The International Fund for Animal Welfare (IFAW) and the Moroccan government's National Agency for Water and Forests (ANEF) (which replaced the High Commission for Water and Forests and the Fight against Desertification) have joined forces to strengthen wildlife and habitat protection
- Morocco is part of the Global Program for the Progressive Control of Transboundary Animal Diseases (GF-TADs), the Regional Animal Health Centre (RAHC), and the Mediterranean Animal Health Network (REMESA), and works with the FAO Emergency Centre for Transboundary Animal Diseases (ECTAD-FAO)
- The Integrated Control of Neglected Zoonoses (ICONZ) project supported by the EU between 2009 and 2015 focused on human health and animal production through scientific innovation and public engagement. In Morocco, work focused on diseases transmitted from dogs (rabies, hydatidosis, leishmaniasis) and from cattle (tuberculosis and brucellosis) to humans. The results were published and presented for a PhD.

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for Laboratory Animal Science. Draft legislation (Projet de Loi 122-12) on animal well-being and the prohibition of animal suffering was produced in 2013 and contains guidance on animal health, animal welfare and food safety but does not extend to improving animal welfare; the law is not yet enforced. An ethics committee in science, animal health, and veterinary public health was created in 2021 at the IAV Hassan II. It is mainly composed of research professors in veterinary medicine and a single zootechnician. Human health also has an ethics committee composed of professor-researchers from the Faculty of Medicine of Hassan II University.



- Transhumant pastoralism is an important activity in southern Morocco, with approximately a fourth or more of livestock in mobile systems
- High number of protected and conserved areas, but limited overall terrestrial and marine protected area coverage
- Rich marine biodiversity and prioritization of aquaculture as a priority sector

MOROCCO CASE STUDY:

Rabies

CURRENT STATUS

Overview: In Morocco, this tragic disease continues to be enzootic and is a major public health problem. Several national plans for rabies control have been carried out in recent decades as a part of efforts to eliminate the disease. Unfortunately, their objective has not been achieved to date due to a multiplicity of constraints, which are the insufficient means granted to carry out medical and sanitary actions (particularly the dog vaccination and control of stray dogs), the lack of coordination between the different departments involved, and the insufficiency of parallel actions. In many African countries including Morocco, rabies prevention and treatment centers are located mainly in large cities. Therefore, the centers are not easily accessible to rural populations due to their remoteness or lack of awareness about their existence.

A framework agreement of partnership and cooperation was signed between the Ministry of the Interior, represented by the General Directorate of Local Councils; the National Office of Food Safety (ONSSA); the Ministry of Health; and the Moroccan National Order of Veterinarians. The actions covered by this agreement consist essentially in capturing stray dogs and cats throughout the national territory. These animals are then identified, vaccinated against rabies, dewormed, and sterilized. Following such interventions and after a period of rehabilitation within a pound, the animals are returned to the places where they were collected in order to respect their familiar environment.

Rabies continues to be endemic in the canine population. Between 2004-2019, approximately 280 cases have been reported annually in animals. Reported cases included dogs, which constitute the reservoir and vector for this disease in the country, bovids and equid species, and more rarely, ovine, caprine, and feline species. In humans, approximately 20 cases occur each year, with three-fourths in rural areas. Animal cases also mainly occur in rural areas.

HIGH-LEVEL STRATEGIES

In Morocco, anti-rabies prophylaxis, both sanitary and medical, dates back to the beginning of the 20th century. At that time, the stamping out of stray dogs and the surveillance of dogs by their owners were only applicable to dogs within the urban perimeter and did not cover the numerous stray dogs in the peri-urban agglomerations, in the douars (a name given to rural communes). Stray dogs would frequently seek out food in weekly souks. Vaccination of dogs against rabies started in Morocco in 1925. These vaccination campaigns have continued throughout the kingdom but have not achieved the desired objectives of eliminating rabies nationwide. From 1986 to 2010, two rabies control plans were implemented in Morocco. They consisted mainly of free mass anti-rabies vaccination of dogs with an owner as well as sanitary measures through targeted and continuous stamping out of stray dog populations.

The National Rabies Control Plan (PNLR), established in 1986, aimed in the short term to reduce rabies incidence and in the long term to make Morocco a rabies-free country. The strategy implemented was

Rabies

based on the elimination of the stray dog population coupled with the vaccination of at least 70% of dogs with an owner following WOAHA recommendations on interrupting dog-dog and dog-human transmission. The evaluation of the actions undertaken revealed weak results, with the persistence of both animal and human rabies cases. The main causes identified were a poor application of both medical and sanitary prophylaxis measures, limited public awareness about the dangers of rabies, and inefficiency of intersectoral collaboration due to a lack of precision of the tasks of each stakeholder. However, this program produced some beneficial impacts, such as improvement of equipment and infrastructure of regional veterinary laboratories for rabies diagnosis, training of technicians assigned to diagnosis, and establishment of a national unit for the production of veterinary rabies vaccine.

In 2001, a new strategy for rabies control in Morocco was put in place. It was generalized to the whole national territory in October 2004 through a circular from three interministerial departments (Ministries of the Interior, Health, and Agriculture) specifying the requests of each of these departments in rabies control. The main lines of this strategy focused on actions carried out during the previous control plan, plus the strengthening of medical and sanitary measures through targeted and continuous stamping out and the implementation of support measures relating to regular epidemiological surveillance of the disease, development of animal pounds, upgrading of modern and rural slaughterhouses, and the fencing of public dumps, especially in rural areas. However, all the actions carried out to the current day have remained insufficient and the disease continues to be enzootic at the national level, despite an apparent decrease in the number of new cases per year in animals in recent years.

The actions of medical and sanitary prophylaxis carried out under the national plan for rabies control have experienced a clear slackening over time, a direct

consequence of the introduction of new animal diseases threatening the national livestock population (West Nile Fever in 2003, Ovine Catarrhal Fever in 2004, PPR in 2008, and FMD from 2015 to 2019). These health events have prompted the competent veterinary authority to make changes in priorities in the health programs; specifically, the funds allocated to the fight against canine rabies have been redirected to the safeguarding of livestock. The possibility of integrating these plans with the approach of oral vaccination, which has proven its effectiveness on the experimental level in Morocco, has been suggested, to increase vaccine coverage in the stray dog population that is not accessible for parenteral vaccination. Oral vaccination complements but cannot replace parenteral vaccination; therefore, it will be appropriate, as a first step, to strengthen mass vaccination campaigns for dogs with inactivated rabies vaccines. Oral vaccination is indeed a very expensive and difficult method to implement on a large scale for dogs.

Aware of the fact that it is a societal tragedy to see rabies, a 100% preventable zoonosis, still killing people in the 21st century, with the added financial cost of post-exposure treatments, Moroccan authorities have decided to propose new and reinforced actions that have proved their effectiveness in other countries, while respecting animal welfare. Several NGOs have recently expressed, through social networks and the media, their concern with the stamping out of stray dogs in different provinces of the kingdom during previous plans to fight this disease. In addition, international organizations do not recommend the stamping out of dogs as a method for rabies control, as mass parenteral vaccination remains the only effective method. Accordingly, in February 2019 a framework agreement of partnership and cooperation was signed between the Ministry of the Interior, represented by the General Directorate of Local Councils; the National Office of Food Safety (ONSSA), the Ministry of Health, and the Moroccan National Order of Veterinarians. The agreement sets actions consisting mainly of the capture

of stray dogs and cats throughout the national territory, to be identified, vaccinated against rabies, treated against parasites, and sterilized; once sterilized, they will be returned to the place where they were collected to respect their familiar environment. Achievement requires support measures in place for training of the personnel in charge of the collection of animals, the installation of fences, the hygienic improvement of garbage dumps (a source of food for stray animals), and the creation of pounds having a surgery room with the construction and equipment standards needed for sterilization. Each of the partners will be responsible for financing the actions that have been assigned to it. The first installment of 40 million dirhams (\$4.3 million) has been made available for this program by the Ministry of the Interior. Other payments will follow according to the needs presented by the communes. The surgical interventions, anti-rabies vaccination, anti-parasite treatment, and identification of the animals will be done by private veterinarians with a fixed fee according to the type of animal (between 250-800 dirhams, or \$27-86). The equipment, vaccines, medicines, and other materials will be paid for by ONSSA and the local councils of the Ministry of the Interior. Public awareness campaigns on the dangers of rabies and the means for its prevention will be conducted by the departments of the Ministry of Health and ONSSA.

For the monitoring and evaluation of these actions at the national level, a central commission will be created, bringing together representatives of the parties concerned by the convention and chaired by the representative of the Directorate of Local Councils. At the local level, technical commissions will be designated and chaired by the representative of the local commune, province, or region. Additionally, the Ministry of Health has reinforced the establishment of Rabies Prevention Centers covering all the provinces of the Kingdom to ensure the systematic management of post-exposure prophylaxis. To give this new program a more efficient One Health approach, the integration of other stakeholders has been recommended (e.g.,

Ministry of National Education, Department of Communication, animal welfare groups).

SURVEILLANCE AND DETECTION

The main observation that emerges from analysis of the current epidemiological situation of rabies in Morocco is that after several decades of control of the disease, there are still cases of animal rabies in a large part of the country. While the number of rabies cases in dogs has been decreasing since 2005, data on rabies in ruminants show an epidemiological pattern comparable to that recorded in the 1980s and 1990s. This reveals, firstly, the extent of underreporting of canine rabies, but also raises critical questions about the effectiveness of the control approach adopted to date to reduce the impact of the disease. The current state of affairs does not allow for an epidemiological analysis that is compatible with the realities of the field - in terms of the spatial and temporal dynamics of the disease. The epidemiological situation of animal rabies in Morocco is characterized by very general indicators that do not allow for a very specific epidemiological analysis of the observed trends of the disease, including the geographic and temporal situation. Field observations show that rabies surveillance in the canine reservoir species remains inadequate. This is mainly due to the lack of awareness of the population about the disease, especially in rural areas. A dog showing symptoms is immediately slaughtered and buried, hence the decrease in the number of cases diagnosed in dogs and the increase in the number of cattle, because the farmer is more concerned about cattle than a roaming dog. It would be wise to strengthen the surveillance of the rabies reservoir and vector species in the new national strategy.

PREVENTION AND CONTROL

The factors affecting the transmission and control of rabies in Morocco are not understood enough so as to favor the design of the most appropriate control strategy and thus avoid losses of effort and resources.

MOROCCO CASE STUDY:

Rabies

Despite the importance of dogs as vectors of human rabies, very little is known about the spatial dynamics of rabies in this major reservoir species, nor about the processes responsible for its maintenance in specific geographic locations. Health managers do not have tangible evidence to guide disease control. The effectiveness of animal rabies control in Morocco is closely linked to data completeness and quality, which are prerequisites for more reliable epidemiological analysis. In general, different types of factors are involved in the evolution of animal diseases, be they genetic, biological, but also environmental, climatic, political, economic, demographic, and societal, therefore requiring a multi-sectoral approach.

REGIONAL CONSIDERATIONS

The countries of the region have virtually the same epidemiological profile, but no inter-regional collaboration has been addressed so far. Morocco is part of the Middle East, Eastern Europe, Central Asia and North Africa Rabies Control Network (MERACON) under the Global Alliance for Rabies Control and participates in its knowledge exchange events. The country has not undertaken the Stepwise Approach towards Rabies Elimination assessment.

IMPLEMENTATION GAPS

- Several constraints are responsible for the persistence of this disease, the main ones being:
 - Insufficient measures in the fight against the disease (medical and sanitary actions)
 - The multiplicity of stakeholders and insufficient interministerial collaboration, despite the existence of an interministerial circular signed in 2003 between three ministries
 - Insufficient financial means for implementation

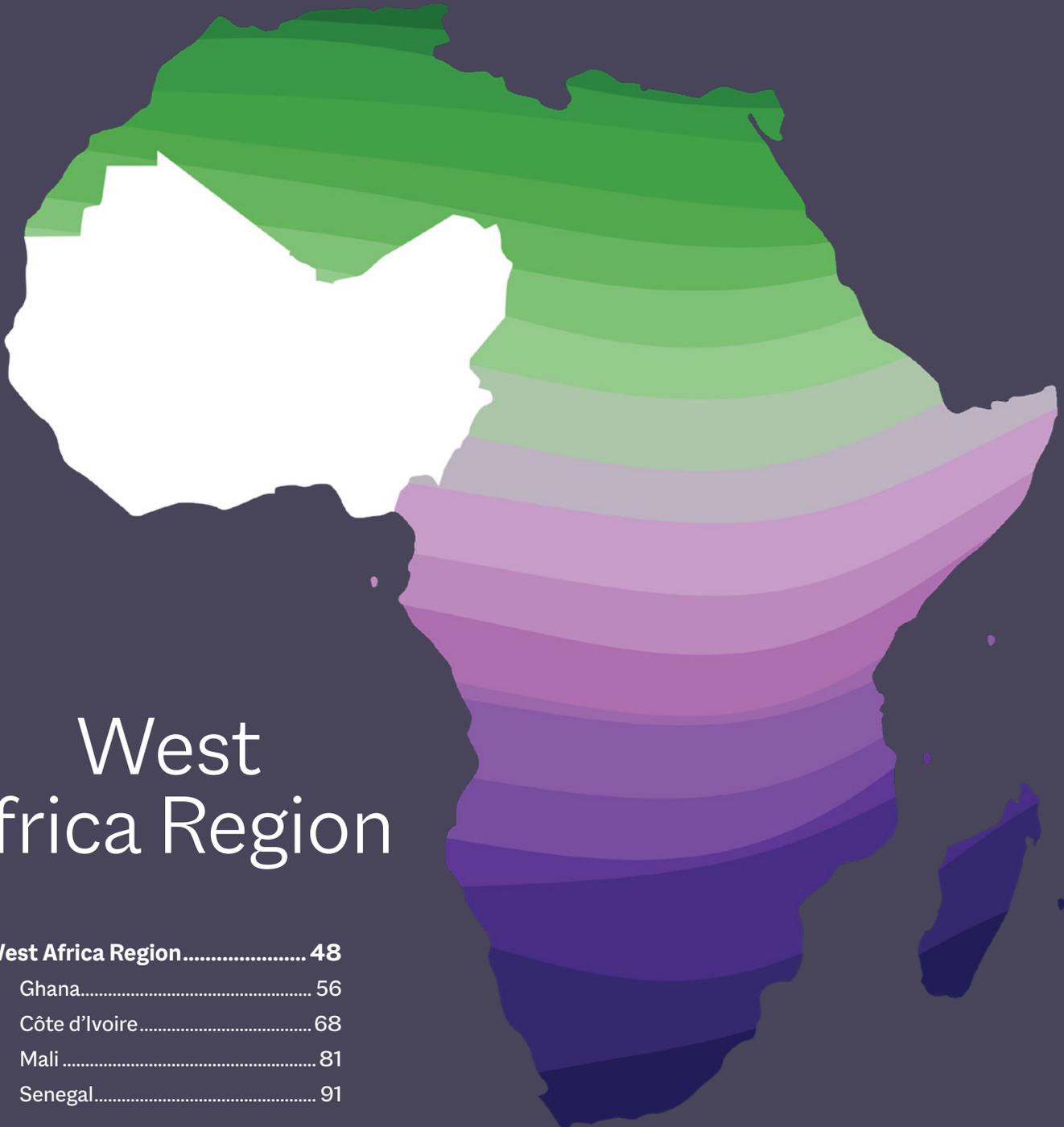
- Lack of public awareness of the importance and danger of rabies
- Insufficient management of garbage (public dumps) and rural slaughterhouses
- Poor knowledge of the socio-ecology of the dog population (in terms of its dynamics, social life, status of the dog, and other factors)

KEY RECOMMENDATIONS

- Infrastructure improvement (rural slaughterhouses, public dumps, markets, etc.)
- Regulations on the keeping of dogs in rural and peri-urban areas, to make owners responsible for keeping dogs in their homes, to prohibit the disposal of litters of puppies in the wild, and the maintenance of a health record for each dog
- Strengthening intersectoral collaboration and revitalizing provincial rabies control committees
- Continuation and intensification of medical prophylaxis actions through massive vaccination of dogs with owners and adequate management of the stray dog population, ideally supported by active and sustained involvement of the municipalities
- Development and implementation of oral vaccination of inaccessible or difficult-to-reach dogs as a complement to parenteral vaccination
- Regular education and awareness campaigns about the disease

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West Africa Region

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West Africa Region

CONTEXT

The West Africa region is defined by the United Nations as Benin, Burkina Faso, Cabo Verde, Côte d'Ivoire, Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone, and Togo. It forms part of the Gulf of Guinea (shared with parts of coastal Central Africa), the Upper Guinean rainforest, and the Southern edge of the Sahel. An estimated 31% of the total population — and just over half of the urban population — live along its coasts.¹

The diverse ecosystems in the region support rich biodiversity, among them chimpanzees, elephants, pangolins, pygmy hippos, and sharks. West Africa's faunal and floral diversity, as well as transit routes from Central Africa, make it vulnerable to wildlife trafficking. Among other environmental degradation issues are desertification, deforestation, imported e-waste, and effects of commercial and artisanal mining. Additionally, sea level rise and flooding threatens coastal areas, particularly in areas with mangrove destruction. Several countries in the region are recognized as 'hotspots' for disease emergence, with recent filovirus events (e.g. Ebola Zaire, Marburg) and annual transmission of Lassa fever virus, while still facing transmission of typhoid, malaria, and lymphatic filariasis, among other endemic diseases.

The region has a high degree of informal employment. Subsistence crop and livestock farming, including nomadic pastoralist practices (particularly along the Sahel), contribute substantially to livelihoods and food security. Livestock are a major trading item among countries in the region, especially from Sahelian regions to coastal populations.² Climate change-associated heat stress, heavy rainfall events, and decreased rainfall in the west, present threats to agricultural production.

CURRENT SITUATION

Regional coordination and governance initiatives

The Economic Community of West African States (ECOWAS), established in 1975, is the primary economic and governing community in the region. ECOWAS is an economic and integration community aimed at fostering relations among its Member States, maintaining and enhancing economic growth, raising the standard of living, and contributing to the progress and development of the African continent.

ECOWAS is involved in coordinating animal and public health activities in the region, in particular through the West African Health Organisation (WAHO), the Regional Animal Health Centre (RAHC), a Regional Veterinary Laboratory Network (RESOLAB), the Regional Center for Disease Surveillance and Control (RCSDC), and the Regional Epidemiological Surveillance Network (RESEPI). WAHO is tasked with human health protection via knowledge exchange and harmonized Member State policies, pooling resourcing, and cooperation. Côte d'Ivoire, Guinea, Liberia, and Sierra Leone form the Mano River Union, a partnership on cross-border issues affecting trade and economies, as well as health and natural resources.

There is a regional One Health structure in place via ECOWAS. In 2017, ECOWAS implemented a Regional One Health Coordination Mechanism (R-OHCM), and convened a One Health technical meeting of member states in 2019 in Lomé, Togo that brought together focal points for human health, animal health and environment from member state countries. At a regional level, challenges of the R-OHCM include lack of more specialized workforce and a harmonized reporting structure, an inadequate focus on operational research, and funding.³

SWOT ANALYSIS | WEST AFRICA REGION

S

STRENGTHS

Strong high-level and technical commitment by countries and regional organizations to One Health as a way of working

Availability of regional veterinary training facilities for Francophone nations

Presence of regional bodies (WAHO, RAHC, RESOLAB and RCSDC) that coordinate animal, public health and disease surveillance

One Health Platform in most member countries

Strong participation in FELTP initiatives, including some animal health and environmental workforce

W

WEAKNESSES

Low and uneven participation in veterinary training programs for English-speaking countries

Challenges in production and supply chain, including sourcing of reagents

Outdated/inadequate veterinary and wildlife protection legislation and enforcement, including at borders

Absence of One Health training course in most countries

Limited funding for One Health Operationalisation

Relatively low environment sector integration and resourcing in One Health initiatives

Absence of ECOWAS wide integrated disease surveillance and control

Existing activities primarily focused on disease surveillance

O

OPPORTUNITIES

Presence of an African Science Partnership for Intervention Research Excellence (ASPIRE) that can assist in developing human capacity

Presence of large-scale disease surveillance and response projects including ALERT and REDISSE.

Strong role of ECOWAS in advancing One Health in region can facilitate knowledge exchange, commitments, and progress

Presence of regional Legislation on Transhumance

T

THREATS

Region vulnerable to climate variability and change

Most countries are a hotspot for disease emergence

Scale and scope of wildlife trafficking, agriculture industry, land use changes present new or changing risks

Transhumant livestock risk introduction and spread of diseases in countries of transit and destination

All West African countries have adopted a One Health platform strategy. However, there are varying stages of the full formalization and implementation of the strategy due to logistical challenges of coordinating at different levels. In most countries, the One Health strategy is yet to be decentralized and implemented at county and district levels. At the national level, One Health is not integrated into the strategy of sector ministries. To date, the One Health strategy in the region is focused on zoonoses. In general, the strategy is not broadened to cover important topics such as climate change, environmental degradation, and AMR.

Regional diseases of concern and relevant risk management measures

In 2018, 7 zoonotic diseases were prioritized for the ECOWAS region by member states meeting in Dakar, Senegal (Box on priority zoonoses).⁴ Climate change presents a substantial vulnerability and risk factor for management of disease; the burden of climate change on health systems in West Africa is expected to be relatively higher than other regions based on the chronic gaps in health systems and infrastructure. Climate change is shifting host distribution and occurrence patterns of infectious diseases from ecological effects and greater contact with animals.⁵ West Africa is important for migratory birds over wintering from temperate areas; however, the wetland ecosystems they depend on are highly threatened by climate and land use changes.⁶ Similarly, major poultry production investments in the region are shifting the dynamics of poultry-waterfowl interactions. Infectious diseases themselves can affect wild birds, increasingly presenting a threat to wildlife health and conservation.

Rabies in West Africa

Rabies is a zoonotic disease of importance in the region. There is no routine mass vaccination in the region, leaving vaccination to isolated campaigns during annual World Rabies Day celebrations taking place in

Box: Regional priority zoonoses

- Anthrax
- Rabies
- Ebola and other viral hemorrhagic fevers (e.g. Marburg fever, Lassa fever, Rift Valley fever, Crimean-Congo Hemorrhagic fever)
- Zoonotic influenzas
- Zoonotic tuberculosis
- Trypanosomiasis
- Yellow fever

countries. The NGO Rabies in West Africa (RIWA) is championing the elimination of rabies. RIWA's work focuses on rabies awareness, responsible pet ownership education, dog population management, and research. Member countries have organized, in collaboration with other One Health stakeholders, mass rabies campaigns. RIWA has hosted 7 annual conferences (up to 2021). To date, most West African countries have taken up the Stepwise Approach to Rabies Elimination, facilitated by RIWA; however, few have reached stage 2.

Transboundary Animal Diseases

Pastoralist communities rely on internal and cross-border mobility as a resilience strategy, for livestock grazing, water resource, trade, and disease avoidance. The extent of such movements are highly varied in the region, and can be driven by a number of factors, including conflict and access to veterinary services.⁷

Transboundary diseases are common in the region and may spread through transhumance.⁸ Common transboundary diseases of concern in the region include Brucellosis, foot and mouth diseases, Contagious Bovine Pleuropneumonia (CBPP), Rift Valley Fever, Rabies, African Swine Fever (ASF), PPR,

Avian Influenza, and Newcastle disease.⁷ ASF and PPR are considered endemic in the region. Avian Influenza H5N1 outbreaks are also affecting the region in recent years, including the 2021-2022 period.

Legislation from countries in the region around transhumance, including through protected areas, is poorly operationalized, and current national level disease surveillance and control activities are ineffective in the control of transboundary diseases.⁸ Livestock are susceptible to disease exposures and infections, with reported high mortality associated with transhumance.⁹ Several recent development projects, such as the Regional Pastoralism Support Program for Africa (PRAPS) project under the World Bank, have helped to strengthen access to livestock services in pastoralist communities in Burkina Faso, Chad, Mali, Mauritania, Niger, and Senegal, but animal health infrastructure remains uneven. Transhumance certification is adapted to control disease spread; livestock disease surveillance and cross border meetings of ECOWAS veterinary services are also among preventive measures being taken.

Through the World Bank, the International Development Association (IDA)-financed Regional Sahel Pastoralism Support Project (PRAPS) supported livestock assets in Sahelian countries: Burkina Faso, Chad, Mali, Mauritania, Niger, and Senegal, focused on pastoral systems. Key outputs included infrastructure around water points, pasture for livestock, vaccination stations, livestock markets, and fodder storage.

The movement of livestock across borders for trade also presents risks in the region, with introductions of PPR recorded through this route, for example.

Regional prevention and control measures

The ECOWAS Regional One Health Coordination Mechanism (R-OHCM) has established 7 taskforces that facilitate operationalization (Box on task forces). In 2018 an ECOWAS One Health Zoonotic Disease Prioritization (OHZDP) exercise was conducted to prioritize zoonoses of greatest regional concern and develop action plans for addressing these diseases

Box: ECOWAS Task Forces

- surveillance and health information systems
- preparedness and response
- risk communication
- research and training
- laboratory and antimicrobial resistance
- animal health
- environmental health

through a One Health approach.¹⁰ The recommendations made in the ECOWAS OHZDP workshop match themes found in the Africa CDC's "Framework for One Health Practice in National Public Health Institutes",¹¹ including aligning recommendations, building upon the implementation of One Health tools, and strengthening surveillance activities and regional surveillance networks for the priority zoonotic diseases. As of 2018, nine (60%) ECOWAS Member States had identified priority zoonotic diseases and established a national One Health platform: Burkina Faso, Côte d'Ivoire, Ghana, Guinea, Liberia, Mali, Nigeria, Sierra Leone, Senegal.¹² A key need is to translate these to sub-national levels.

The Regional Animal Health Center (RAHC) and the Regional Center for Disease Surveillance and Control (RCDS) maintain collaborative surveillance activities throughout the region, with support from international partners. The Regional Animal Health Centre, based in Bamako, Mali, has played a key role in implementation of the 2007-2020 ECOWAS Agricultural Strategic Plan, coordinating and harmonizing M&E strategies for avian influenza and transboundary animal diseases.¹³ The RAHC also coordinates the USAID-funded One Health in West Africa project, which supports regional capacity through ECOWAS related to One Health policy development, disease surveillance, and response, and intersectoral collaboration and coordination.

West Africa

The RCSDC, based in Abuja, serves as the regional One Health coordinating institution, to facilitate sustainability of regional One Health coordination. WAHO has played a key role as the Center is being operationalized.

Programs operating across the region, like the World Bank's Regional Disease Surveillance System Enhancement (REDISSE) project and the regional DHIS-2 platform, have helped support national and

regional surveillance for zoonotic diseases.^{14,15} The EBOSURSY project, under WOA, has also focused efforts on capacity development for Ebola virus surveillance in wildlife in several countries in the region. Building on this initiative, in June 2022 WOA organized a regional training workshop in Ghana on Viral Haemorrhagic Fevers (VHF) surveillance protocols, bringing together WOA Delegates and National Focal Points (for Disease Notification, Communication, Laboratories and Wildlife) from Sierra Leone, Liberia, Nigeria, Ghana and Uganda.

The Mauritanian Network for the Epidemio-surveillance of Animal Diseases (REMEMA) has monitored sentinel herds (camels and small ruminants) since 2000, playing

Box. Regional disease prevention and control projects

ALERT Project

The African coalition for Epidemic Research, Response and Training (ALERT) brings together a network of Africa countries and European partners, 6 of them belonging to the Institute Pasteur International Network. Within West Africa, the Institut Pasteur de Côte d'Ivoire, Institut Pasteur de Dakar, Kumasi Centre for Collaborative Research in Tropical Medicine, Kwame Nkrumah University of Science and Technology (KNUST) and the Medical Research Council Unit in the Gambia (through London School of Hygiene and Tropical Medicine) are partners (Centre Pasteur du Cameroun, Institut Pasteur de Bangui, Institut Pasteur de Madagascar, and Institut Pasteur in Paris are also participating). A 'response framework' is being established to address administrative, regulatory and ethical bottlenecks often seen in epidemic response detection and response, in order to support improved outbreak control and strengthening of operational research capacity (e.g. evaluation of new diagnostics and treatments).

REDISSE

The REDISSE program, through financing of >\$600 million in West Africa, is supporting human and animal infectious disease surveillance and response system strengthening in ECOWAS countries, including implementation of Epidemiological Surveillance Centers at the health district level. WAHO plays a role through the management of regional activities. In West Africa, REDISSE beneficiary countries include Guinea, Guinea-Bissau, Liberia, Sierra Leone, Togo, Benin, Mali, Mauritania, Niger and Nigeria. Funding from the program, which was launched in three phases (plus a fourth outside of the region), has helped to support a range of activities, including formalization and operationalization of national One Health coordination mechanisms, infrastructure enhancements in veterinary and human health laboratories, and emergency response to disease events including COVID-19. In Mauritania, the project is hosted at the livestock and agriculture authority (which is now known as the Ministry of Rural Development).

a key role in the ability to enhance RVF monitoring around high rainfall periods.

The Regional Animal Health Network (RAHN), also overseen by ECOWAS, serves as a platform for science and policy knowledge exchange on animal health interventions. At a RAHN meeting held in 2021 through FAO, ECOWAS, AU-IBAR, WOA, USDA, and Brooke West Africa, topics of focus included animal health surveillance, risk assessment, and early warning of potential disease outbreaks, including integration of human and animal disease information. The meeting also involved observers from several African nations outside of the region for broader benefit. Recommendations from the RAHN have already helped to inform high-level discussions through the ECOWAS Specialized Technical Committee on Food and Agriculture.¹⁶

Regional training pipelines and research collaborations

The Inter-State School of Veterinary Sciences and Medicine of Dakar (EISMV) is a veterinary school in Dakar, Senegal. Serves as the main veterinary training institutions for French-speaking countries in the region, EISMV has 15 Member States participating in its operating budget: Benin, Burkina Faso, Cameroon, Côte d'Ivoire, Congo, Gabon, Mauritania, Niger, Central African Republic, Rwanda, Senegal, Chad, Togo and Mali. The school has a diploma course on One Health and recently developed a wildlife management masters course, but low enrollment has been reported for the latter. For English-speaking countries, there is no regional training pipeline, though the University of Ghana's veterinary school, established in 2011, offers an important training pathway.

Field Epidemiology and Laboratory Training Programs (FELTP) are increasingly providing a key in-service training pipeline in the region. In particular, the Ghana Field Epidemiology and Laboratory Training Program (GFELTP) is a competency-based program established in October 2007. The GFELTP currently runs the Advanced Program, the FETP-Intermediate and the FETP-Frontline trainings in Ghana. It began as an initial collaboration with the United States Centers for

Disease Control and Prevention (U.S. CDC), through cooperative agreements with the University of Ghana School of Public Health and Ghana Health Service. The program has evolved into a sub-regional resource center for training field epidemiologists from English speaking West African countries (except Nigeria, which is discussed below). The GFELTP is a founding member of the African Field Epidemiology Network (AFENET), headquartered in Kampala, Uganda. The GFELTP seeks to train field epidemiologists, veterinary epidemiologists and public health laboratory scientists for leadership positions in government agencies. Skills development supports outbreak investigations, data analysis, and surveillance system evaluation.

The Nigeria Field Epidemiology Training Program (FETP) is a 2-year field-based program in and through support of the Nigeria Centre for Disease Control (NCDC)/Federal Ministry of Health and the Federal Ministry of Agriculture & Rural Development. Through AFENET, the Program receives technical and financial support from the U.S. CDC (PEPFAR, the President's Malaria Initiative, Division of Global Health Protection and Global Immunization Division). The program trains medical epidemiology residents, public health laboratory residents, and veterinary epidemiology residents for government leadership positions, using extended field placements and didactic courses. In addition, the program offers competency-based field epidemiology training to local government frontline health care workers, to support enhancements in surveillance and response for priority disease to meet core capacity obligations under the IHR.¹⁷ Other countries have also established FETP programs, which provide opportunities for all levels of government service at the beginner, intermediate, and advanced levels of certification. In countries such as Liberia where veterinary workforce is lacking, participation from animal health workforce has been limited in the program, though is growing. There is still not a clear path for participation by environment sector workforce (water quality experts, wildlife managers, park rangers) in most countries, despite many FETP projects having an environmental aspect. However, there are several large-scale biodiversity conservation and ecosystem-

West Africa

based climate change mitigation and adaptation projects in the region that could integrate human and animal health and biosafety considerations, including around wildlife trade. A project in Liberia, launched in 2021 and supported by USAID in collaboration with the Liberian Forestry Development Authority, is integrating a One Health approach in protected area establishment and management and sustainable livelihoods.

Many academic training institutions are yet to include One Health scope in their programmes, resulting in a lack of experts to support in-service work and train-the-trainer initiatives. At present, the FETP, while an excellent applied training pipeline, only operates at a graduate level and is also medically and to some extent veterinary biased. A key need is to introduce One Health

Box. Examples of regional training projects.

AFRICA One-ASPIRE

The African Science Partnership for Intervention Research Excellence (ASPIRE) was active in West Africa, with regional partners in Cote d'Ivoire (Swiss Centre for Research (CSRS), Ghana (Noguchi Memorial Institute for Medical Research (NMIMR), University of Ghana), and Senegal (EISMV).

WEST AFRICAN CENTRE FOR CELL BIOLOGY OF INFECTIOUS PATHOGENS, UNIVERSITY OF GHANA (WACCBIP)

The Centre leads research for the development of new approaches to disease diagnosis, prevention and control. Priority diseases include protozoa (malaria, trypanosomiasis), mycobacteria (tuberculosis, Buruli ulcer), rotaviruses, influenza, and dengue fever.

coursework at the undergraduate level at Medical, Veterinary, Environment Schools and other related tertiary institutions in member countries or in identified institutions in the West Africa region.

There are several Institute Pasteur facilities in West Africa, in Cote d'Ivoire and Senegal (as well as neighbouring Cameroon), which are members of the Global Institute Pasteur Network. Their mission contributes to: Research, Health protection and promotion; Providing expertise in public health; Education; High quality services (clinical diagnosis, human vaccination, and food safety testing); and Production of human vaccines. These Institutes provide critical capacity, though are primarily tailored to serving the national system or French-speaking nations, rather than the region as a whole.

REGIONAL PRIORITIES AND COMMITMENTS

Indications of interest to take on One Health and veterinary programs and systems strengthening

While some routine One Health activities (e.g. regular technical meetings) were slowed during COVID-19 response, overall regional coordination continued during the pandemic, including through virtual technical workshops in the three ECOWAS languages. At national levels, there is high-level political will in place that helps to sustain progress; for example, Liberia's national One Health Coordination Platform is chaired by the Vice President. Participation countries in the World Bank REDISSE program, which includes a portion of credit-based financing, signals that countries see the long-term value of human and animal health system investments; however, these still have a large public health bias: of 11 countries participating, only one (Mauritania) housed the project within a veterinary authority.

ECOWAS Veterinary Services has reinforced the importance of harmonized regional legislation, including on Animal Welfare, as well as the mobilization of resources for animal health issues. The institution is also taking on broader regional issues, such as the

evolving situation with theft, slaughter, and intercontinental export of donkey meat and hides — a topic of high interest for the region given dependence on donkeys for transport and agriculture, recent equid disease events, and the overall link to wildlife and other trafficking in West Africa.

Through the Regional Veterinary Laboratory Networks (RESOLAB) Regional Epidemiological Surveillance Network, there is interest in establishing regional diagnostic centers, building on Member States competencies — such as for Highly Pathogenic Avian Influenza (HPAI) detection, PPR diagnostics, and Contagious Bovine Pleuropneumonia (CBPP) vaccine production. There is also a push to ensure all animal health projects have some aspects that contribute to network activities.

Opportunities to leverage regional COVID-19 activities

Some countries and institutions, such as Ghana, the Nigerian CDC, and the Pasteur Institute have both veterinary and research laboratories that were instrumental in the COVID-19 surveillance and control, providing essential support and surge capacity. Nigeria and Senegal have been selected as countries to receive capacity support through the mRNA Technology Transfer Hub, which seeks to accelerate vaccine production capabilities. The WHO has provided a water quality mobile lab to Mauritania.

A key need is to introduce One Health coursework at the undergraduate level at Medical, Veterinary, Environment Schools and other related tertiary institutions in member countries or in identified institutions in the West Africa region.



Ghana

Completed Assessments and Plans

JEE	PVS Evaluation	PVS Evaluation Follow-Up	PVS Gap Analysis	PVS Legislation	IHR-PVS Bridging Workshop	NAPHS	OHZDP	National AMR Action Plan	NBSAP
2017	2008	2016	2011	2017	2022 (Rabies)	2018	2018	2017	2017

Indicator

Country Region Average Continent Average

Coordination and Financing

Multi-sector and One Health collaboration/coordination for AMR (1-5)	4.00	2.20	2.44
Collaborative effort on activities to address zoonoses (0-100)	60.00	55.00	54.23
Current health expenditure per capita (USD)	75.28	58.69	132.25
CFE disbursements (USD)	0.00	2,361,848.00	4,903,032.44

Workforce

Veterinarians (total)	871.00	909.00	3,512.00
Veterinarians (per 1,000 people)	0.03	0.08	0.17
Public animal health professionals (total)	35.00	52.00	461.00
Public animal health professionals (per 1,000 people)	0.00	0.01	0.02
Medical doctors (total)	3,236.00	5,967.00	8,574.00
Medical doctors (per 1,000 people)	0.11	0.17	0.41
Up-to-date multisectoral workforce strategy (1-5)	2.00	2.03	2.19
Progress with strengthening veterinary services (1-5)	3.00	2.80	2.80

Demographic Factors

Population (total)	30,417,858.00	24,464,630.38	24,185,802.76
Population growth (% ,2010-2019)	22.80	27.01	23.73
GNI per capita (USD)	2,230.00	1,335.62	2,525.37

Environmental and Sanitation Factors

Land area (sq km)	227,540.00	378,979.38	548,414.71
Arable land (% land area)	20.66	19.19	14.14
Forest area (% land area)	35.06	27.66	27.57
Terrestrial protected areas (% land area)	15.04	15.52	16.27
Average primary forest loss (ha)	6,265.89	6,105.65	20,326.14
Access to basic drinking water – rural (%)	67.50	56.77	55.48
Access to basic drinking water – national (%)	81.50	69.53	69.76
Access to basic hygiene – national (%)	41.00	21.94	26.71
Access to basic sanitation – national (%)	18.50	30.23	40.71

Animal Factors

Average livestock stocks (LSUs)	2,750,552.00	4,615,777.30	5,551,123.37
Average livestock exports (LSUs)	109.61	20,487.72	33,314.93
Average livestock imports (LSUs)	83,059.86	36,990.70	31,044.50
Mammal species (number)	314.00	230.06	241.65

STATUS OF ONE HEALTH AND VETERINARY SYSTEMS

The Veterinary Services Directorate (VSD) sits within the Ministry of Food and Agriculture. While many government services have been decentralized to the local level, VSD remains centralized to ensure rapid response to disease outbreaks and surveillance reporting. District veterinary officers directly report to the Director of Veterinary Services. VSD has 10 regional veterinary offices, aligning to most regions of the country. Three Epidemiology Units located in Northern, Middle, and Southern Ghana are tasked with disease surveillance and data management and reporting. The Veterinary Public Health and Regulatory Unit oversees slaughter facilities, certification of export and import of animals (domestic and wild) and animal products, as well as the importation of veterinary drugs and food of animal origin, together with the Ghana Food and Drug Authority.

The Ministry for Fisheries and Aquaculture Development also has veterinary officers that handle matters related to wild and farmed fish. The Ministry of Environment Science, Technology and Innovation (MESTI) and the Ministry of Lands and Natural Resources are responsible for environment and wildlife issues, respectively. The Wildlife Division of the Forestry Commission is the government authority responsible for managing wildlife within and outside of protected areas. The Wildlife Division collaborates with VSD regarding free ranging and captive wildlife, although VSD is responsible for the health of wild and domestic in Ghana. The two agencies also collaborate in the export certification out and import of wildlife into Ghana; Veterinary Services is responsible for providing health certification and the Wildlife Division certifies that trade meets CITES requirements. The Wildlife Veterinary Unit, within the Wildlife Division, coordinates diseases surveillance by wildlife rangers and reports to VSD.

The Environmental Protection Agency (EPA) collaborates with VSD during disease outbreaks, especially regarding the hygienic and proper disposal of

dead animal carcasses. EPA has been actively involved in the stamping out of poultry in the ongoing control of avian influenza in Ghana, as this involved mass killing of birds and thus proper disposal. Within the Ministry of Health, there are also environmental experts, focused on aspects including toxicology and air quality. However, there is limited coordination among agencies on environmental aspects of One Health, with overall low empowerment of the environment sector in One Health and health security initiatives.

The Public Health Services, Food and Drug Authority (FDA), and the Disease Surveillance Unit of the Ghana Health Service (GHS) work closely with VSD on zoonoses and other diseases, environment (slaughter inspection), and nutrition. The FDA works with the Veterinary Services in providing quality veterinary drugs and animal food and supplements for Ghanaians. The Director of Veterinary Services serves on FDA boards and committees.

The Ghana Health Services, Environment Protection Agency, Wildlife Division, and VSD are financed by the national budget, in addition to internally generated funds. Contingency funds exist during disaster events, such as COVID-19. Donor funding in the form of projects contribute significantly to funds for the various departments.

One Health Coordination

Several ministry directors led a situational analysis of One Health operationalization in Ghana. The analysis identified three key challenges: 1) an absence of a legal and institutional framework to guide multi-sectoral coordination and implementation of One Health activities; 2) fragmentation and lack of coordination due to multiple funding agencies supporting different One Health activities; and 3) siloed implementation of One Health activities due to institutional mandates and no formalized system for sharing health data across agencies.

Informed by the analysis, a One Health Technical Working Group (OHTWG) was established in 2018 (see box on the working group composition). It aims to

SWOT ANALYSIS | GHANA

S

STRENGTHS

One Health Coordination Platform and existing One Health scope

Reporting of wildlife disease events is standard

Extensive official protected areas

Ongoing efforts aimed at strengthening One Health workforce including strong field epidemiology training programs Veterinary bills currently under review or newly launched aims at increasing veterinary capacity and monitoring of professionals

Vaccination production capabilities and annual vaccination campaigns

Strong laboratory capacity, including AMR reference laboratory

Veterinary Service is decentralized and present in almost every district

Data collection on wildlife trade

Extensive training institutions – two established veterinary schools and one technical college

W

WEAKNESSES

One Health coordination platform has not been formalized with governance structure

Ad-hoc surveillance during outbreaks and reliance on facility-based surveillance for detection; Poor real time data collection

Wildlife surveillance is extremely limited due to limited financial resources

Weak border staff from wildlife and veterinary service to enforce law

Limited wildlife trade regulation and law enforcement

Veterinary legislation is outdated

Lack of field data and research on some diseases and interaction at wildlife-livestock-environment interface

Limited wildlife and environmental experts engaged in One Health workforce projects

Limited One Health line items and reliance on external sources for funding

Fragmentation of environmental health space makes it challenging to engage environment and wildlife stakeholders

Limited veterinary presence in rural areas

Laboratories poorly resourced and lack needed reagents

O

OPPORTUNITIES

National interest in a One Health approach; National Disaster Management Organization provides a unique host for coordination platform

In-service epidemiology training programs for veterinary and para-veterinary staff, and mobile app for animal disease reporting

Academic institutions available for building One Health pipelines

Collaborations between VSD and GHS on surveillance data sharing for zoonotic diseases can engage environment agency

Ongoing wildlife census

Communities and indigenous knowledge can be engaged in surveillance for sensitization and training by the VSD

Rapid response teams in most districts – human health, security, animal health

T

THREATS

Transhumance and changing migration based on resource availability may intensify conflicts and increase exposure to animal and environmental threats

Poultry industry is prioritized for growth, but faced recent avian influenza outbreaks

Disease threats from porous borders, development projects supporting livestock expansion in proximity to wildlife habitats, wildlife hunting practices, transhumance

Unregulated or illegal mining displacing wildlife, driving invasive species, and polluting drinking water

Extreme climate and weather events affecting health, livelihoods, food security

raise awareness and promote buy-in on One Health, develop a Policy to provide the legal framework for implementation, develop an Action Plan, and coordinate, support, and monitor the implementation of One Health.

The OHTWG plans to hold high-level advocacy sessions, develop a roadmap to guide activities for the finalization and passage of the One Health policy, develop a national action plan and monitoring framework for the implementation of One Health, and develop a resource mobilization plan to support coordination and implementation of programs.

The OHTWG submitted a national policy to the Ghanaian government for its operationalisation informed by nationwide consultative meetings. It has yet to be operationalised with an official legal instrument. As of 2022, the National Disaster Management Organization (NADMO) hosts the secretariat and coordinates the activities of the One Health coordination platform. The platform is chaired by the Ministry of Health (Ghana Health Service) and co-chaired by Ministry of Food and Agriculture (Veterinary Services Directorate) and Ministry of Environment, Science, Technology and Innovation (Environmental Protection Agency). The governance structure may change once the policy is launched.

Without national backing, the OHTWG lacks the legal mandate to institutionalize implementation of One Health across all sectors. There is weak commitment and absence of funding from the government of Ghana. Activities to date have largely been funded by WHO and FAO.

The U.S. Naval Medical Research Unit - 3 (NAMRU-3) Ghana detachment conducts scientific research and public health initiatives with the Noguchi Memorial Institute for Medical Research (NMIMR), Ghana Health Services, the Veterinary Services of Ghana, and Ghana Armed Forces. Projects under this collaboration include surveillance and research on febrile illness, Influenza surveillance, arthropod-borne pathogens, and other infectious diseases in Ghana. In one study, “Arthropod-

borne pathogens in vectors and livestock in Navrongo, Upper East Region, Ghana”, an objective is to determine a sentinel animal. In recent years, the NAMRU-3 Ghana detachment has also assisted other countries in the region, including setting up Ebola virus diagnostic laboratories and providing appropriate training in Liberia.

Box:
**Composition of Ghana's
One Health Technical
Working Group**

- Ministry of Health
- Ministry of Food and Agriculture
- Ministry of Environment, Science, Technology and Innovation
- Ministry of Local Government and Rural Development
- Ministry of Sanitation and Water Resources
- Ministry of Lands and Natural Resources
- Ministry of Fisheries and Aquaculture
- Ministry of Finance
- National Development Planning Commission
- Ghana Health Service
- Veterinary Services Directorate
- Environmental Protection Agency
- Noguchi Memorial Institute for Medical Research
- University of Ghana School of Veterinary Medicine
- Medical Directorate, Ghana Armed Forces
- Wildlife Division, Forestry Commission
- National Disaster Management Organization
- WHO
- FAO

Training Pipelines

Ghana has two veterinary schools, located at the University of Ghana (in Accra) and the Kwame Nkrumah University of Science and Technology (KNUST) (in Kumasi). In addition, plans are far advanced to establish a third veterinary school, at the University for Development Studies in Northern Ghana. There is also a Veterinary College for technical level training, and the University for Development Studies in Tamale currently offers a degree in veterinary nursing. The University of Ghana's School of Public Health offers a postgraduate One Health course for medical and veterinary professionals and has now created modules for environmental professionals with first admission in the 2021/2022 academic year. Ghana's Field Epidemiology and Laboratory Training Program (GFELTP) is for English Speaking West Africa, except Nigeria (see Regional report).

Many of the public universities host One Health research groups, including the Noguchi Memorial Institute for Medical Research at the University of Ghana, the Kumasi Collaborative Centre Research at KNUST, and public health departments at both the University of Ghana and KNUST. Ghana Health Services also maintains health research centers (the Kintampo Health Research Centre, Navorongo Health Research Centre, and Dodowa Health Research Centre), which focus on neglected tropical diseases and entomology. These centers train GHS environment nurses. The EPA also has an Environmental Institute, which trains environmental officers.

Ghana faces a shortage of veterinary staff with the training necessary to face expanding and evolving responsibilities and increasing livestock production. This is particularly true with respect to specialists in the fields of veterinary public health and epidemiology. Private veterinarians are concentrated in urban areas; the presence of veterinarians in rural settings, and for livestock, is more limited. Current field staff require

refresher training on modern disease surveillance and reporting. Two bills aim to modernize legislation regarding the veterinary workforce: One bill proposes to establish the Veterinary Health Services, which would increase the number of staff needed to deliver effective veterinary services in the country; the second bill has been put forth by the Veterinary Council, which empower them to monitor para-and private veterinary practices and business, including animal welfare.

Since November 2021, FAO and partners are implementing an In-Service Applied Veterinary Epidemiology Training (ISAVET) pilot, focused on emerging infectious diseases and transboundary animal diseases in 14 countries of East, Central and West Africa, including Ghana. Veterinary and para-veterinary staff are being trained on basic epidemiology and disease reporting to strengthen on disease surveillance and early warning in the country. The pilot training is supported by the United States Agency for International Development (USAID) under the Global Health Security Agenda. Graduates of ISAVET will be issued certificates from the Tertiary veterinary schools. There is also ongoing discussion with public health schools so that ISAVET graduates could be admitted for higher degrees. The UK Animal and Plant Health Agency is also partnering with Ghanaian institutions to reinforce applied veterinary epidemiological training. FAO, in collaboration with Veterinary Services, also carried out training for wildlife field staff in 2021, focused on disease surveillance and zoonoses, to enhance wildlife disease surveillance reporting capabilities.

DISEASE MANAGEMENT

Surveillance and Reporting

The VSD conducts surveillance for several reportable diseases (Table). Active surveillance is only undertaken during an outbreak, which limits the potential for early warning, and passive surveillance occurs through field district veterinary services and the veterinary laboratories. Reliance on facility-based surveillance for disease detection leads to poor EID surveillance and



- Substantial volume of hunting and trade of some wild animals, including bats
- Deforestation and desertification in north of country; reforestation a priority
- Increasing transhumance (including through protected areas) during dry season
- Development of irrigation dams creating vector breeding and invasive species conditions
- Major gold producer; galampsey (small-scale surface mining) degrades agricultural lands and increases invasive species and vectors, wildlife displacement, chemical contamination
- Fishing practices (e.g. trawling) reducing marine stock, increasing reliance on other protein sources
- Various development projects encouraging large scale intensive farming (pig and small ruminant production) but lack adequate biosecurity and veterinary staff
- Transit hub for wildlife trade in sub-region; weak veterinary and wildlife law enforcement at borders
- Insufficient sanitation and inadequate drainage system exacerbated by flooding
- Slash and burn practices (e.g. for charcoal) and encroachment into wildlife habitat

response. In urban areas, veterinarians in urban areas are an important part of animal disease surveillance system for domestic animals. There are few veterinarians in rural districts and working with livestock; this workforce requires training on disease surveillance and reporting. Despite known endemicity of pathogens associated with viral hemorrhagic fevers, there is variable access to screening for differential diagnosis outside of common pathogens, particularly in certain belief systems (e.g. sorcery, traditional healers).

The VSD also manages a Sheep & Goat Investigation Farm in Techiman (in Brong Ahafo Region of the country). The farm studies the dynamics of endoparasites in the transitional ecosystem. The Tsetse and Trypanosomiasis Control Unit, located in Pong Tamale, a region of Northern Ghana, carries out tsetse and trypanosomiasis surveillance and control.

Funding for disease surveillance is limited. There is no government budget for wildlife disease surveillance for high-consequence pathogens; most or all funding for pathogen surveillance in wildlife, and for unknown infections in humans, has been driven by research support from external donors, such as the USAID

Emerging Pandemic Threats PREDICT project that ran until 2019. Three veterinarians are engaged on the topic but lack training on wildlife disease surveillance and wildlife capture. A passive surveillance system needs setting up to provide regular information on wildlife health. This can be supported by training on wildlife data transmission, storage and retrieval (i.e., data banking). Despite this, Ghana was the only African nation to voluntarily report to WOA's World Animal Health Information System wildlife interface (WAHIS-Wild) between 2008-2018.

VSD and GHS share zoonotic disease surveillance data, particularly on the One Health priority zoonoses selected during the One Health Zoonotic Disease Prioritization (OHZDP) exercise in 2018. Data sharing also occurs for Brucellosis and tuberculosis. During outbreaks, VSD leads active surveillance on the One Health priority zoonoses. There is daily sharing of data on COVID-19. VSD, which is responsible for wildlife health in Ghana, receives surveillance data and reports on mass mortalities from Wildlife Veterinary Officers. There is limited collaboration with Environmental Protection Agencies.

VSD partners with the FAO to enhance country capacities on risk assessment, disease surveillance, and laboratory diagnostics for zoonotic pathogens as well as livestock diseases. As part of this effort, Ghana has taken up use of the FAO-launched Event Mobile Application tool (EMA-i) to support early animal disease reporting at the national level. The tool has helped facilitate daily reporting opportunities for surveillance data from remote locations to VSD. A key feature of the tool is the option for sharing of zoonotic disease alerts on the platform across animal health, human health and environment officer users. In Ghana, EMA-i has enabled sharing of weekly human and animal disease surveillance data between the human and animal health sectors. The Integrated Disease Surveillance and Response (IDSR) framework is utilized by the Ghana Health Service, which provides weekly reports on rabies, acute haemorrhagic fever syndrome, yellow fever, and severe acute respiratory syndrome among other prioritized diseases in humans.

Paper-based data collection is conducted for some wildlife species monitoring, including wildlife in markets. This hinders the systematic and continuous monitoring of market trends, including information that could be relevant for disease risk assessment.

Access to Diagnostics and Vaccines

Diagnostics

The VSD has four BSL-2 laboratories, located in Kumasi, Takoradi, Ho and Accra. The Accra, Takoradi and Kumasi laboratories have a BSL-3 facility and support COVID-19 diagnosis. There is an AMR laboratory at the Central Veterinary Laboratory (CVL) in Accra for AMR surveillance, which receives support from FAO. There are also diagnostic facilities in research institution and Universities. The Noguchi Institute for Medical Research (NMIMR), KNUST's Kumasi Centre for Collaborative Research (KCCR), and the BSL-3 veterinary laboratories provide advance detection

Table.
List of vaccines
produced at LANAVET

A. Reportable Schedule Diseases

Rabies
African horse sickness
African swine fever (ASF)
Anthrax
Bovine spongiform encephalopathy
Brucellosis
Contagious bovine pleuropneumonia (CBPP)
Black quarters
Contagious pustular dermatitis/Orf
Dermatophilosis
Epizootic lymphangitis
Foot and mouth disease (FMD)
Fowl pox
Fowl typhoid
Glanders
Gumboro
Haemorrhagic septicaemia
Highly pathogenic avian influenza (HPAI)
Lumpy skin disease
Mange
Marek disease
Newcastle disease
Peste des petits ruminants (PPR)
Pullorum disease
Rinderpest
Swine erysipelas
Trypanosomiasis
Tuberculosis

B. One Health Priority Zoonotic Diseases

Anthrax
Rabies
Trypanosomiasis
Viral Haemorrhagic Fevers (e.g. Ebola, Lassa Fever, Yellow Fever, Dengue Fever)
Zoonotic Avian Influenza
Zoonotic Tuberculosis

capabilities. NMIMR and KCCR have the only sequencing platform in the country. In the case of Rabies, the CVL experiences stock outs of reagents and kits often expire. There had been a project with the government of Canada to explore manufacturing reagents in country slated to end in 2022, but this capacity is still under development.

Vaccination

Besides diagnostic services, the CVL produces a thermostable Newcastle vaccine, and the Pong Tamale Veterinary laboratory in Northern Ghana produces an Anthrax spore vaccine, hemorrhagic Septicaemia vaccine and Blackleg vaccine. These vaccines, including for Newcastle disease, are sold to farmers at a minimum cost recovery price for prophylactic vaccinations. Vaccinations as part of outbreak control in affected areas are provided by government for free.

Annual vaccination is undertaken in some areas for Newcastle disease in rural poultry, Anthrax in livestock, CBPP and Hemorrhagic Septicaemia. Ghana is a beneficiary of the WOAHA *Vaccine Standards and Pilot Approach to PPR Control in Africa (VSPA)* project sponsored by the Bill and Melinda Gates Foundation. This project has provided a vaccine bank in the West African sub-region for the control of PPR, and there is nationwide PPR vaccination under way toward the goal of PPR eradication by 2030. However, there are

challenges of transport and other logistics in ensuring timely nationwide vaccinations of small ruminants. Toward rabies prevention and control, some rabies-endemic districts provide annual rabies vaccination through the support of the assemblies and non-governmental organizations (e.g., RIWA-Ghana, Mission Rabies), though vaccination coverage sufficient for elimination has not been reached.

PREVENTION AND CONTROL MEASURES

Ghana has piloted several applied tools to support multi-sectoral coordination and risk reduction. In 2021-2022, through support of the UK Animal and Plant Health Agency in collaboration with the University of Ghana and EcoHealth Alliance, this included a country assessment tool for environmental health, an emerging infectious disease risk profile examining emergence, spread, vulnerability, and protective factors; and a review of climate change and emerging infectious disease links in Ghana that convened the national One Health platform. In August 2022, Ghana hosted an IHR-PVS National Bridging Workshop on Rabies. Ghana also previously conducted a national training on the FAO, WHO, and WOAHA Joint Risk Analysis tool in 2019.

The Wildlife Division is vested with the law to protect Wildlife; as a result, hunters have to obtain permits to hunt designated species of animals, mainly rodents. Wholly Protected Species including non-human

Box. International Initiatives and Projects in Ghana (examples)

- The Canadian International Development Agency has provided a P.3 laboratory facility in the 4 regional laboratories that assisted in the diagnosis of COVID-19 in Ghana.
- The Enhancing Global Health Security project is operating in several countries in the region (e.g. Ghana, Burkina Faso, Nigeria, Senegal). Funded by the U.S. CDC, it is focused on capacity strengthening as assessed by the JEE to meet IHR obligations, and addressing operational gaps. Within Ghana, the project takes a One Health Approach, with multi-sectoral partners including GHS, VSD, NMIMR, EPA, and the School of Public Health, University of Ghana.

primates, big cats, some antelopes, and elephants are not hunted as per the wildlife regulations. While not specifically designed with disease prevention in mind, the law does in effect limit hunting and trade of some species and taxonomic groups associated with disease risk. Other epidemiologically important taxa (e.g. bats) are not covered under the regulations.

In late June 2022 two suspected cases of Marburg virus disease were reported and confirmed by laboratory testing shortly after. This was the first instance of the virus reported in the country. Efforts are underway through Ghanaian institutions and partners to characterize exposure risks to inform risk communication and mitigation measures.

ETHICS

Ghana has a Data Protection Commission. It is required that Institutions including academic institutions register with this national body. There are legal instruments protecting animal welfare and hunting of wildlife. Permits are also provided to researchers for wildlife research.

The Centre for Scientific and Industrial Research (CSIR) has an Institutional Review Board/Animal Care and Use Committee (IRB/IACUC) for both local and international research approval. The various Universities have their internal Ethics committees. The Ghana Health Services has an ethical committee for human clinical research at the teaching hospitals and Kintampo Research Center. The Veterinary Council of Ghana has also submitted a revised Veterinary Council Bill that has captured Animal Welfare and also requests for permission to demand ethics permission for animal research.

The University of Ghana has Institutional Animal Care and Use Committee (IACUC), and collegial committees including the following Ethics Committees – Ethic committee of health sciences, Ethic committee of the humanities, Ethic committee of the Basic and applied science and Institutional Review Board (IRB).

In 2021, Ghana hosted the 5th African Animal Welfare Conference, which is co-organized by the Africa Network for Animal Welfare, UNEP, and AU-IBAR. A key output was an Animal Welfare Nexus Resolution for Sustainable Development, introduced by Ghana at the UN Climate Conference in November 2021 (COP26) and adopted at the 5th United Nations Environment Assembly in 2022.

GHANA CASE STUDY:

Trypanosomiasis

CURRENT STATUS

Tsetse fly- transmitted trypanosomiasis presents a threat to more than 60 million people and over 70 million livestock on the African continent. In Ghana, African Animal Trypanosomiasis (AAT) constrains livestock production systems and agricultural development overall. Ghana is situated within the tsetse infested belt of sub-Saharan Africa; the majority of the country's vegetative cover is infested with tsetse flies and by extension trypanosomiasis.

In Ghana, prior detection studies indicate a wide variation in trypanosomiasis prevalence in cattle, sheep and horses across the country. *T. vivax* is reported as the most prevalent in the Northern and Upper West Regions, then *T. congolense* (Savannah type) and *T. brucei*.

Key impacts include animal deaths and production losses, and human infections (causing "sleeping sickness", which can be fatal). A key consequence of infestation is abandonment of farming practices in these areas. Neighboring countries (i.e. Burkina Faso, Mali, Niger and Nigeria) have substantial land areas outside of the tsetse infested belt. Changing practices related to livestock management, human settlement and crop agriculture can affect exposures to tsetse flies.

Trypanosomiasis in Ghana is transboundary in nature. It is a nationally- notifiable disease and comes under the legal framework of international regulations.

HIGH-LEVEL STRATEGIES

The African Union Pan African Tsetse and Trypanosomiasis Eradication Campaign (AU-PATTEC) provides a coordinating role for control of the disease. In 2000 African Heads of States and Governments were called to sign a protocol for the creation of tsetse free areas across common borders, as well as the

establishment of this secretariat role at the African Union Commission for coordination of tsetse control activities between affected African Countries. The strategy is focused mainly on vector elimination.

Under the AU-PATTEC initiative, a tsetse intervention programme was conducted in the Upper West Region of Ghana. This intervention was highly successful (recording a vector reduction rate of 98%), and is being scaled up in the Upper East; North East; Northern and the Savannah Regions through the Tsetse Control Unit.

The Tsetse Control Unit employs an integrated programme of tsetse suppression procedures: Trap and Target deployments; Ground spraying; live-baiting; Aerial spraying and the use of Sterile Insect Technology to overcome remnant flies in controlled areas. Financing for all field activities is funded from the Government's annual budgetary allocation through the Government's flagship agricultural reform campaign, under its livestock Rearing for food and Jobs component and the Modernizing Agriculture in Ghana program of the Ministry of Food and Agriculture (MOFA).

The systematic expansion of the intervention coverage from the Upper West Region, through to the Upper East Region in tandem with the North East, Northern and the Savannah Regions has progressed at a slower pace than planned, owing to insufficient project

GHANA CASE STUDY:

Trypanosomiasis

funding. An awareness creation campaign is also ongoing in areas freed from tsetse infestation to encourage uptake of livestock and crop production ventures.

SURVEILLANCE AND DETECTION

Surveillance is conducted primarily in livestock, wildlife, and the tsetse fly. Trypanosomiasis is monitored in humans as in animals, using parasitological, serological and molecular diagnostic methods.

Active surveillance uses parasitological surveys to detect positive cases of trypanosomiasis in animal population. Determination of positive cases of trypanosomiasis in animals triggers therapeutic measures. Tsetse population suppression efforts are also implemented, such as insecticide treated nets, ground spraying and live-baiting in infested areas.

For human African trypanosomiasis (HAT), positive cases must be immediately reported to WHO for appropriate drugs to be provided for treatment and control. HAT prevention efforts also trigger tsetse suppression efforts as with animal cases.

Passive trypanosomiasis surveillance is conducted by monitoring the quantity of trypanocides used by livestock farmers and/or marketed by pharmaceutical companies. Other indicators of trypanosomiasis burden include effects on calving rate, calf survivorship rate, milk yield and body mass index.

PREVENTION AND CONTROL

At present, the approach to control trypanosomiasis in Ghana is based on the 2000 African Union Pan-African Tsetse and Trypanosomiasis Eradication Campaign (AU-PATTEC) strategy. Tsetse suppression efforts are ongoing. In addition, continuous screening of livestock is conducted to determine impact of the control efforts. One key challenge being targeted is to break the cycle

of disease transmission via trypanocidal chemotherapy of affected livestock, which can occur via mechanical transmission through infected syringes, particularly given the concern over potential spread of resistant strains.

Control methods currently being practiced in Ghana include: Insecticide (use of Deltamethrin), treated screens/tsetse traps, ground spraying, live baiting, aerial spraying and the use of sterile insect technology. Under the Regional Animal Health Center (RAHC), the West African nations are currently formulating a regional strategy for the control of trypanosomiasis and tick-borne diseases. This is being undertaken through Component 4 of the Regional Dialogue and Investment Project for Pastoralism and Transhumance in Sahel and Coastal Countries of West Africa (PREDIP), aimed at combatting vector-borne diseases.

IMPLEMENTATION GAPS

Implementation of the AU-PATTEC initiative to eliminate tsetse and trypanosomiasis from the African continent has suffered several implementation gaps. Key gaps include:

- Failure of affected countries, sharing common borders, to join the initiative that seeks to remove the transboundary problem associated with the disease, due to internal and cross border conflicts
- The lack of adequate/common funding for countries ready to participate in the AU-PATTEC initiative; as evidenced in Ghana, where government funding is insufficient and sporadic for the disease

KEY RECOMMENDATIONS

- Develop a West Africa regional strategy to control vector borne diseases including trypanosomiasis
- Establish a financing mechanism (e.g., donor support) for a continuous control of the disease
- Include all relevant stakeholders in control efforts - particularly authorities with Human Health, Environment Health and Animal Health mandates, given the classification of Trypanosomiasis disease as a One Health Priority zoonotic disease in the country
- Conduct research into the current control methods and adopt environmentally friendly approaches to avoid insect resistance and impacts on non-target species



Côte d'Ivoire

Completed Assessments and Plans

JEE	PVS Evaluation	PVS Evaluation Follow-Up	PVS Gap Analysis	PVS Legislation	IHR-PVS Bridging Workshop	NAPHS	OHZDP	National AMR Action Plan	NBSAP
2016	2006	2011	2013	2015	2021	2018	2017	2020	2016

Indicator **Country** **Region Average** **Continent Average**

Coordination and Financing

Multi-sector and One Health collaboration/coordination for AMR (1-5)	2.00	2.20	2.44
Collaborative effort on activities to address zoonoses (0-100)	60.00	55.00	54.23
Current health expenditure per capita (USD)	75.09	58.69	132.25
CFE disbursements (USD)	0.00	2,361,848.00	4,903,032.44

Workforce

Veterinarians (total)	897.00	909.00	3,512.00
Veterinarians (per 1,000 people)	0.04	0.08	0.17
Public animal health professionals (total)	95.00	52.00	461.00
Public animal health professionals (per 1,000 people)	—	0.01	0.02
Medical doctors (total)	4,173.00	5,967.00	8,574.00
Medical doctors (per 1,000 people)	0.16	0.17	0.41
Up-to-date multisectoral workforce strategy (1-5)	2.00	2.03	2.19
Progress with strengthening veterinary services (1-5)	2.00	2.80	2.80

Demographic Factors

Population (total)	25,716,554.00	24,464,630.38	24,185,802.76
Population growth (% , 2010-2019)	25.20	27.01	23.73
GNI per capita (USD)	2,290.00	1,335.62	2,525.37

Environmental and Sanitation Factors

Land area (sq km)	318,000.00	378,979.38	548,414.71
Arable land (% land area)	11.01	19.19	14.14
Forest area (% land area)	9.28	27.66	27.57
Terrestrial protected areas (% land area)	22.88	15.52	16.27
Average primary forest loss (ha)	21,541.31	6,105.65	20,326.14
Access to basic drinking water — rural (%)	57.80	56.77	55.48
Access to basic drinking water — national (%)	72.90	69.53	69.76
Access to basic hygiene — national (%)	19.40	21.94	26.71
Access to basic sanitation — national (%)	32.10	30.23	40.71

Animal Factors

Average livestock stocks (LSUs)	1,811,465.87	4,615,777.30	5,551,123.37
Average livestock exports (LSUs)	561.13	20,487.72	33,314.93
Average livestock imports (LSUs)	40,400.34	36,990.70	31,044.50
Mammal species (number)	318.00	230.06	241.65

STATUS OF ONE HEALTH AND VETERINARY SYSTEMS

Animal and human health systems in Côte d'Ivoire are pyramidal, with three administrative structures at national, regional and departmental levels. The Ministry of Animal Resources and Fisheries (MIRAH) is responsible for implementing and monitoring government policy on animal production and fisheries resources. The central level is composed of the Minister's office, the Directorate of Veterinary Services (which is one of nine central directorates) and the Project for the Improvement of Animal Health and Veterinary Public Hygiene (PASA-HPV). The latter is in charge of defining policies, supporting and ensuring global coordination in the field of veterinary public health. Twenty-four Regional Directorates supervise and coordinate the veterinary public health activities of the Departmental Divisions. Those Departmental Divisions (58), Livestock, Aquaculture, and Fisheries Posts (262) and Border Entry and Inspection Posts (14) are responsible for the operationalization of the veterinary public health policy. Thirteen pig Sanitary Defense Groups (GDSs), 10 poultry GDSs, and 1 ruminant GDS also participate in the epidemiological surveillance of diseases and contribute to their control. Besides the public sector systems, several Sanitary Defense Groups for Swine, Poultry, and Ruminants participate in disease surveillance and control. There is a small private veterinary sector composed of 30 veterinarians, and 13 private veterinary pharmaceutical wholesaler-distributors who import more than 90% of their products.

The human health sector is similarly organized into three levels. It is dominated by a strong public sector and a growing private sector, alongside traditional medicine. There are 20 Regional Health Directorates and 113 Departmental Health Divisions or Health Districts. The private health sector has developed in recent years with the emergence of private health facilities of all classes and categories (e.g. polyclinics, clinics, medical centers and practices, pharmacies, private posts) and is mostly present in large urban areas. As of 2014, the private pharmaceutical sector

offered up to 90% of the medicine supply. This includes 1,100 private pharmacies and 8 drug production units, of which 4 are in operation, and contribute 6% of the national pharmaceutical market. The Ministry of Health and Public Hygiene (MSHP) has integrated traditional medicine as an alternative to the health needs of the population to improve health coverage and reduce disparities and inequalities in terms of access of the population to quality care. This sector has more than 8,500 Traditional Medicine Practitioners listed by the National Program for the Promotion of Traditional Medicine.

The Ministry of Environment and Sustainable Development (MINEDD) is responsible for monitoring and planning issues related to the environment, biodiversity, and sustainable development, in collaboration with other ministries, including Tourism, Environment and Water and Forests, and Construction, Sanitation, and Urbanism. MINEDD oversees a series of agencies mandated to monitor environmental health: The National Environment Agency, which deals with development policies, plans, programs, and projects in Côte d'Ivoire, the Ivorian Anti-Pollution Center, whose mission is to evaluate pollution and nuisances by systematically analyzing the quality of natural surface waters, and the Ivorian Office of Parks and Reserves (OIPR), which manages and enforces laws in all parks and reserves (which comprise almost 1/4th of territory). A foundation created within the OIPR ensures sustainable funding for this sector. The designation of community managed and private protected areas has been strongly encouraged in recent years due to the high deforestation and degradation rates.

Policies and actions related to climate and agriculture are implemented mainly by the Ministry of Environment and Sustainable Development (MINEDD), the Ministry of Agriculture and Rural Development, the Ministry of Animal Resources and Fisheries (MIRAH), and the Ministry of Water and Forests (MIREF). The Ministry of Water and Forests collaborates with the Ministry of Environment and Sustainable Development to implement national policies related to wildlife

S

STRENGTHS

- National One Health Platform backed by government and in operating texts
- Anchoring of the One Health Platform in the Prime Minister's Office
- Provisional Technical Secretariat
- Appointment of most of the One Health focal points in the various partner ministries
- Four functional Technical Working Groups
- Functional and dynamic Public Health Emergency Operations Center
- Experience and familiarity with working in a multi-sectoral setting for most members in human, animal, and environmental health
- Strong and operational general and technical directorates
- Efficient laboratories
- Human resource expertise
- Existence of an order by the Prime Minister for the coordination and management of the COVID-19 pandemic
- Decision to rotate the Technical Secretariat between different ministries to ensure involvement and empowerment of every sector

W

WEAKNESSES

- Absence of an order appointing the Coordinator, the Permanent Technical Secretary, and the seven members of the Technical Secretariat to the One Health Platform
- Temporary appointment and competing priorities of Technical Secretariat members
- Lack of appointment of some focal points
- Lack of awareness of the Platform's activities among health actors and its merits and importance among stakeholders
- Lack of ownership of One Health approach by other non-governmental actors
- Lack of a dedicated space for the Platform
- Lack of an operating budget to implement the various work plans
- Pre-eminence of human health in the Platform and among most actors
- Weak engagement by the Ministry of Water and Forests
- Absence of the One Health Platform in response to COVID-19
- Lack of accreditation of veterinary diagnostic network laboratory
- Lack of functional link between One Health Platform and Emergency Operations Centers

O

OPPORTUNITIES

- Government willingness to fund the Platform
- Existence of Technical and Financial Partners willing to fund the Platform (e.g. Technical Working Groups)
- Strong willingness of Animal health sector to be fully committed to the One Health approach
- Existence of a well-functioning information circuit
- Continue/expand recent water quality monitoring of continental, lagoon and coastal waters
- Review legal frameworks for specific zoonotic disease interfaces, e.g. relating to hunting and trade in wild animals

T

THREATS

- Potential lack of ownership and strong political commitment at the Ministry level based on assigned leadership of Platform
- Risk that the top departmental levels do not fully embrace the One Health approach
- Political changes of the Prime Minister's Office, resulting in institutional instability
- Operational management of the PHEOC devolved to the MSHP
- Limited capacity/resources (financial, structural) of relevant ministries to engage in multi-sectoral collaborative activities

protection, sustainable resource management, and bush fire prevention and control. The Ministry of Agriculture and Rural Development organizes and controls phytosanitary protection. The Institution for Aeronautical and Meteorological Development plays a key role in monitoring and sharing climate and weather information.

One Health Coordination

In 2017, Côte d’Ivoire developed a consensus roadmap for 2016-2019 with implementation funding from the GHSA. One of the key outcomes was the identification of One Health actors in Côte d’Ivoire and the elaboration of a plan to create a One Health platform. The establishment of a functional and sustainable multisectoral coordination mechanism involving actors from the human, animal and environmental health

sectors to combat health threats was also emphasized in the JEE conducted in 2016 to help Côte d’Ivoire meet its IHR obligations. Between 2017-2018, USAID’s PREDICT and Preparedness & Response projects supported the development and validation of the operating documents for the OH platform. The One Health Platform was made official by a Ministerial decree in 2019. It has four key bodies, each with a specific mandate (Table on Mandates): the Monitoring Committee, the Multisectoral Technical Coordination Committee, the Multisectoral Secretariat, and the Technical Working Groups (TWGs) (See Box on Ministries).

The platform, although formally existing since April 2019, is not fully operational despite the progress made to establish governing bodies and documents and the backing from the Prime Minister (a PLUSS focal point

Table.
Mandates of One Health platform bodies

STRUCTURE	MANDATE
Monitoring Committee	<ul style="list-style-type: none"> - Political and decision-making body of the Platform. It is chaired by the Prime Minister. - The Ministry in charge of Health serves as Secretary and the Ministry in charge of Animal Health serves as Deputy Secretary.
Technical Coordination Committee	<ul style="list-style-type: none"> - Coordinating body for the activities of the One Health Platform and is chaired by the Ministry in charge of health with the Director of the National Institute of Public Hygiene serving as Secretary. It is composed of general and central directors, representatives of member ministries and NGOs involved in the implementation of the MSSP.
Multisectoral Technical Secretariat	<ul style="list-style-type: none"> - Ensures the general organization of the One Health platform by: ani-mating and supervising platform actors; Communicating and outreach on the One Health approach as well as implementation of the IHR and MSSP; Monitoring and evaluation of IHR, MSSP and One Health actions; and continuous monitoring of the platform’s progress.
Technical Working Groups (TWG)	<ul style="list-style-type: none"> - The TWGs are responsible for providing recommendations and advice on policies, guidelines, tools, and best practices needed within the framework of the One Health Platform for the prevention and control of health threats in Côte d’Ivoire, and for studying, evaluating, or proposing technical solutions to the needs of the One Health Platform in order to guide and shape the technical content of the work of the Secretariat and the platform as a whole. - The TWGs currently in operation are: Animal Health, Biosafety and Biosecurity, Antimicrobial Resistance, and Risk Communication.

has been appointed from the Prime Minister's staff). As of 2022, only one departmental platform had been created out of the 108 departments in the country. Members of the Technical Secretariat are temporary or hold other appointments concurrently. Several focal points, including those of the Ministry of Health, have not been appointed. Despite this, human health representation is predominant within the platform, with the secretaries of the Monitoring Committee and the

Box. **Ministries involved in the Monitoring Committee**

- Defense
- Interior and Security
- Foreign Affairs
- National Education
- Agriculture
- Animal and Fishery Resources
- Transport
- Budget
- Economy and Finance
- Communication
- Digital Economy and the Post Office
- Environment
- Higher Education and Scientific Research
- Promotion of Women and the Family
- Solidarity
- Wildlife
- African integration
- Sanitation and Hygiene
- Commerce
- Industry
- International representatives from WHO, WOAH, FAO, UNEP

Multisectoral Technical Coordination Committee all coming from the health sector.

Training Pipelines

There has been a five-year program from 2015-2020 to upgrade the veterinary services of Côte d'Ivoire (PMNSV-CI) informed by the PVS evaluation conducted in 2011. The PVS found a limited number of regional veterinarians and private veterinarians at the national level, and a significant, but highly dispersed number of veterinary para-professionals. Efforts have been made to fill the gap observed during the PVS evaluation. These include the modernization of the legislation, which was materialized by the adoption on December 30, 2020 of the law on the veterinary public health code in Côte d'Ivoire. In addition, more than 50 veterinarians have been trained in field epidemiology and the sanitary network has been improved (e.g. the number of breeding stations — the frontline subnational representation of the Ministry of Animal Resources and Fisheries — increased from 174 to 291 throughout the national territory since 2020).

Most of the schools in Côte d'Ivoire are at the Master of Science (MSc) level. The Inter-State School of Veterinary Sciences and Medicine of Dakar (EIMSV) is a regional school in Senegal that trains Doctors of Veterinary Medicine (DVM) that serve the country. In addition, Ivorian veterinarians are also trained in veterinary schools in Europe (e.g. Maison Alfort, Nantes, Lyon, Toulouse, Belgium), and elsewhere in Africa (e.g. in Guinea, Morocco, Algeria, Tunisia). Two universities — Nangui Abrogoua University and Swiss Centre for Scientific Research — offer One Health training in AMR capacity development and risk analysis and food safety, respectively.

The country had its first cohort of the Frontline In-Service Applied Veterinary Epidemiology Training (ISAVET) in 2021. Collectively, the Field Epidemiology Training Program (FETP) and ISAVET have trained about 70 people in field epidemiology between 2018-2021, with support from the U.S. CDC, AFENET, FAO, and USAID. In 2022, the first cohort graduated from the

Intermediate FETP, a nine-month program which is implemented with AFENET.

Several institutions and training laboratories are under the responsibility of MIRAH; namely the Fund for the Promotion of Animal Productions in Bingerville, the School of Animal Production, the Specialized School for occupation of the meat production and breeding sectors, the Ivorian Society of Abattoirs and Charcuterie, the Specialized School for fish farming and fishing in Tiébissou, the Kossou Fishing Center, the Bouaké Production Assistance and Development Center, the ranches and livestock and aquaculture stations, the National Laboratory for Agricultural Development Support (LANADA), and the National Institute for Professional Agricultural Training.

Côte d'Ivoire has signed a Debt Reduction and Development Contract with France, which is currently in its second phase of implementation. Côte d'Ivoire is one of the few countries to specifically include a "Higher Education and Scientific Research" component in its contract with France, entitled "Support for the modernisation and reform of Côte d'Ivoire's universities and grandes écoles" (AMRUGE-CI). This supports thirteen research projects coordinated by Ivorian scientists in national laboratories, in collaboration with French research teams. These laboratories have benefited from scientific equipment and 23 doctoral scholarships.

DISEASE MANAGEMENT

Surveillance and Reporting

Since 2000, Côte d'Ivoire has had a National Epidemic-Surveillance Network for animal diseases enabled through the creation of a national early warning and prevention system for animal diseases. This has been facilitated through the Pan-African Programme for the Control of Epizootics (PACE).

DVS conducts active and passive surveillance. The subnational units of the veterinary services — Regional Directorates, Departmental Directorates, Livestock and

Fishery Products Stations, and Border Entry and Inspection Stations — collect data from farms, live animal markets, slaughterhouses, veterinary practices, and Sanitary Defense Groups. Two units have paper collection forms for immediate reporting and monitoring of animal diseases. The Regional and Departmental Directors fill in the epidemiological information and send it to the DVS, with weekly reporting.

The wildlife sectors have a role in surveillance in the country, including for HPAI at migratory bird staging areas. Currently wildlife disease reporting is not effective despite a designated WOH focal point for wildlife. Active surveillance for avian influenza in migratory bird stop over areas is only carried out during epizootics. This limited activity results from several factors: limited sensitization of the actors in charge of wildlife management, a lack of veterinarians on their staff, and a qualified personnel shortage. However, to date in the framework of the animal health working group of the One Health platform a pilot project on respiratory disease surveillance in wildlife has been selected and will be implemented between 2022-2024 with funding from the U.S. CDC. Additionally, through the first phase (2021) of ISAVET, two OIPR agents have been trained in wildlife disease surveillance. In addition, the Wildlife Directorate is considering recruiting veterinarians. The lack of adequate funding for wildlife disease-related surveillance is also a recurrent issue.

Indicator-based human disease surveillance is carried out through the implementation of Integrated Disease Surveillance and Response (IDSR).

In terms of AMR, the national reference center for AMR observatory (ORMICI) has been in operation since 2002. Based at ICPI, it has set SOPs for monitoring and facilitates centralized information sharing and reporting to relevant authorities. It has a One Health scope, aiming to monitor the evolution of antimicrobial resistance regardless of human, animal or environmental origin. It reinforces the multi-sectoral AMR National Action Plan.

Disease surveillance is compartmentalized within government agencies. Several integrated surveillance plans have been developed (e.g. for HPAI, rabies, and Lassa viral hemorrhagic fever), day-to-day there is a lack of collaboration, coordination, and transparency between different government agencies (e.g. LANADA, IPCI), universities and international consortia involved in domestic and wildlife animal health and disease. Sharing of data and information can depend on sending

samples abroad (including obtaining the necessary permissions), and the scientific publication process. For instance, Ebola was detected in chimpanzees in 1994, but the finding was only published in 1999; and a fatal case of Lassa fever was detected through screening of biobanked serum samples in 2015 but not published until 2019. A related issue is the lack of a channel for publication of masters theses (for example, which has led to delays in reporting on tick-borne disease findings). A centralized system to collect findings is needed to improve use of research findings, particularly for early warning.

Box.
Academic and Research Initiatives

Renewed Partnership for Research for Development in Côte d'Ivoire (PRESED-CI 2): Supporting the creation of a research observatory, the Ivorian Telecommunication Network for Education and Research (RITER) and strengthening research capacities in priority scientific fields for Côte d'Ivoire.

Africa Digital Campus Project: The Institute of Research for Development (IRD) and the Educational Research Network for West and Central Africa (ERNWACA) are working together to strengthen the online training of two higher education structures in Côte d'Ivoire.

AFROHUN and One Health Workforce-Next Gen: In April 2018, USAID, the Ministry of Higher Education and Scientific Research, and the Université Félix Houphouët-Boigny announced the launch of the One Health Workforce Program. Under the auspices of MESRS, presented by IPCI Côte d'Ivoire and international partners, this mechanism brings together students and faculty from private and public universities across the country as well as government ministries and international organizations. The University Félix Houphouët-Boigny through the UFR Medical Sciences of Abidjan is a member of AFROHUN.

IRD — As of March 2021, IRD is developing training and research projects on diseases (Buruli ulcer, vector-borne, water-borne and food-borne pathogens, cysticercosis) in collaboration in a One Health spirit with staff from IPCI, LANADA and the country's main universities (Abidjan, Korhogo, Bouaké, Yamoussoukro). They have developed joint research units and a Centre for Medical and Veterinary Entomology (CEMV) at the Alassane Ouattara University in Bouaké at the Pierre Richet Institute in Bouaké which is attached to the National Institute of Public Health (INSP, Ministry of Health). These are mainly research programs, which have also contributed to continuous workforce training.

The **Max Planck and Robert Koch Institutes** have established long-term collaboration with environmental, forestry and veterinary authorities, and with LANADA and OIPR, including programs on zoonoses and chimpanzee and bat viruses and ecology, mainly in national parks and protected areas.

**QUICK
CONTEXT:**
One Health Lens
Côte
d'Ivoire

- Approximately half of the population lives in forest zones
- Nomadic and migratory lifestyles (transhumance)
- Major forest cover loss, replaced with production of cash crops for export
- Limited livestock production requires import of animals and animal products
- Main economic hub of French-speaking West Africa

Access to Diagnostics and Vaccines

Diagnostics

Veterinary diagnostics are primarily conducted by the LANADA Laboratory Network, overseen by the Ministry of Agriculture. The Network includes the Central Veterinary Laboratory in Bingerville, regional laboratories in Bouaké and Korhogo, the Central Laboratory of Hygiene and Agroindustry, and the Laboratory of Ecotoxicology. The Central Veterinary Laboratory routinely diagnoses priority diseases, among them: HPAI, Tuberculosis, Rabies, Swine fever, PPR, Foot and mouth disease, Echinococcosis, and Rabbit viral haemorrhagic fever. It is the only LANADA laboratory that conducts virology work. LANADA is responsible for HPAI surveillance and collaborates with Padua, Italy, the WOAHA reference laboratory for avian influenza strain typing and biobanks. LANADA also participates in inter-laboratory trials with the Padova laboratory for the diagnosis of rabies and HPAI and collaborates with reference laboratories for the phylogenetic characterization of strains.

The 2015 PVS mission noted that LANADA has not obtained accreditation despite significant financial resources of 1 billion FCFA in 2015 (approximately \$1.5 million). This was attributed to issues related to its structure, organization, and management. A related issue is the costs of analyses and the pricing for services. Costs are partly covered by the resources provided by research projects. Reagents only represent about 3% of the budget, but personnel costs are close to 50% and the direct costs linked to infrastructure (investments and consumables linked to administration) more than 40% of the budget. The budget allocated for vehicles is 7.8%, without being allocated to sample transport.

LANADA is able to ensure the detection and analysis of routine samples they receive for HPAI, Rabies, Brucellosis, PPR, African Swine Fever and FMD. Capacity to process higher volumes of samples is limited and as such detection capacity remains a limiting factor in case of multiple or large outbreaks. Biosafety, biosecurity and management issues remain challenges to overcome through laboratory certification aligned on international standards. The need for guidance on how to meet certification standards has been identified.

Vaccination

Regarding animal vaccination, a distinction must be made between vaccines that are under the Ivorian state control in the case of mass prophylaxis and specific sponsored programs by partners. The national campaigns funded by the State only are for the prevention and control of PPR, CBPP, HPAI and anthrax. These campaigns involve private veterinarians who have a sanitary mandate to carry out these campaigns in their respective zones. However, the vaccination coverage is less than 50%. For rabies, there are also mass vaccination campaigns implemented by the State and with the support of partners such as the WOAHA within the context of the vaccine bank, complemented by some vaccination by the private sector and private clients. Overall, mass immunization suffers from insufficient financial and logistical resources. Logistical

issues arise in the organization of vaccination campaigns, especially the mobility of vaccinators and decentralized storage of vaccines.

PREVENTION AND CONTROL MEASURES

In 2017, the government identified eight priority public health threats: acute respiratory distress syndrome, cholera, Ebola, floods, food poisoning, highly pathogenic avian influenza (HPAI), meningitis, and viral hemorrhagic fevers, including dengue, yellow fever, and the chikungunya virus.

Financing for vaccination campaigns is insufficient. As of 2021, the State of Côte d'Ivoire granted a budget of 148 million CFA francs for the year. This allocation is largely insufficient to achieve the vaccination coverage objectives necessary to control animal diseases. For instance, this amount would not enable the vaccination of 70% of the dog population (equivalent to vaccinating approximately 1 million dogs per year) against rabies. Several other diseases (e.g. Peste des Petits Ruminants, Anthrax, Brucellosis, Rabies, Contagious bovine pleuropneumonia, Newcastle Disease, foot and mouth disease) would also benefit from mass prophylaxis if resources were available. There are no standing funds available for emergency management. In the event of a health emergency, communications are made in the Council of Ministers and the necessary funds are made available for this purpose; however, it can take several months to deploy funds through this mechanism. MIRAH is in the process

Box. Diagnostic Initiatives and Projects

The Institut Pasteur de Côte d'Ivoire (IPCI) is building a BSL-3 and BSL-4 facility at its site in Adiopodoume (a suburb of Abidjan) with the help of the French Cooperation and the Institut Pasteur BSL-4 laboratory in Lyon (France). The IPCI is already practicing a One Health approach and is not only dedicated to the diagnosis of human diseases. It is on this site that the USAID PREDICT-supported laboratory has been set up, veterinary research is carried out and the environment and water quality laboratory is installed. A molecular platform is operational (RTqPCR, serology, microbiology and bacteriology). The facility regularly carries out molecular diagnostics for the Ministry of Public Health and Hygiene (e.g. Arbovirus, Coronavirus, Ebola, Lassa, and Monkeypox viruses). By 2019, the buildings were almost finalized but not operational. Funding was not sufficient (but pending) to provide clear research objectives, topics and strategies in line with the Global Health Security Agenda (GHS) and disease focus. Technical guidance will be needed to navigate the certification process. A sequencer was ordered in 2019 but not yet installed. IPCI had expressed the need for on-site training once the sequencer was in place.

Swiss Center for Scientific Research — The center conducts fundamental and applied research activities in the country, including at the intersection of conservation, sustainable agriculture, and human, wildlife, and domestic animal health. Recent projects have focused on great apes conservation, protected area and community involvement, and zoonotic (e.g. rabies), tick, water, and vector-borne diseases. The center maintains the Taabo Health and Demographic Surveillance site, which facilitates study of neglected tropical diseases and has infrastructure for clinical trials. The center hosted the Afrique One-ASPIRE program, a pan-Africa research and capacity strengthen program that ran until 2022 that supported graduate scholars.

of creating a Veterinary Public Health Emergency Operations Unit that will be closely linked to the Public Health Emergency Operations Centre, which is supervised by the Ministry of Health and Public Hygiene.

Brucellosis is a recurrent theme in discussions on the risk of cross-border introduction from neighboring countries. Approximately 60% of the cattle traded in Côte d'Ivoire is from Mali; accordingly, cross-border agreements and vaccination have been put in place. Within the framework of harmonization of cross-border disease control, joint vaccination campaigns are envisioned under the Regional Animal Health Center.

Regulations in Côte d'Ivoire theoretically prohibit hunting throughout the country, but are contradictory in that they also allow hunting permits to be issued under certain conditions. Wild meat is sold in the country along the roads, in the villages and in urban markets without veterinary control. At the same time, the ban on wild meat consumption, enacted during the Ebola crisis in West Africa, has led to increased consumer demand for poultry meat and the rapid establishment of poultry farms without biosecurity. Traditionally raised poultry, largely from Burkina Faso and northern Côte d'Ivoire, present risks for the spread of HPAI H5N1.

Côte d'Ivoire's gender inequalities are among the highest in the world, but One Health coordination does not include a dedicated gender lens at present high participation in animal rearing and caretaking roles important for disease prevention and management. The Ministry of Rural Development is already engaged in the national One Health platform; involving the Ministry of Family, Women, and Children on livestock and zoonotic disease management could also be beneficial.

In 2016, Côte d'Ivoire undertook a PVS Aquatic mission, which evaluates the aquatic animal health system toward meeting WOAHI International Standards. The country is one of only a few in the continent to request the PVS Aquatic evaluation thus far; it was a proactive step as fish contributes a majority of animal protein

consumed in the country and aquaculture is among the industries prioritized in the national development strategy. The evaluation found that the national aquatic animal health system was generally not well advanced in its stages of development for most components, including for disease prevention and control. A key recommendation from the mission, which aligned with findings from prior evaluations in Côte d'Ivoire under the PVS Pathway (evaluation missions using the standard PVS and the PVS Legislation) is to strengthen epidemiological surveillance, including tracking of diseases and linking to reference laboratories for disease confirmation.

ETHICS

There is no institutional animal care and use committee. To date, the Ivorian Office of Parks and Reserves and the Ministry of Animal Resources and Fisheries act as authorities providing research permits for animal sampling. However, in the book on animal welfare, of the law 995 of January 2020 on the code of veterinary public health in Côte d'Ivoire, it is stated that an animal ethics committee should be created by decree.

CÔTE D'IVOIRE CASE STUDY:

Highly Pathogenic Avian Influenza

CURRENT SITUATION

In 2017, the government of Côte d'Ivoire identified eight priority public health threats, including Highly Pathogenic Avian Influenza (HPAI). The growth of the poultry sector is a development priority, and the increase in industrial hatcheries, the professionalization of the poultry sector, and the significant introduction of laying hens in recent years has expanded the sector. HPAI outbreaks have occurred in 2006, 2015, 2017, and most recently in 2021. FAO estimates the economic impact of Avian Influenza in 2017 at nearly 3 billion FCFA (approximately \$4.6 million).

HIGH-LEVEL STRATEGIES

A National Plan for the Prevention and Control of Highly Pathogenic Avian Influenza in Côte d'Ivoire was set to last from 2015-2018 (see Box on measures outlined in the Plan); the same plan has been implemented during the last epizootic in 2021 with expected revision later in 2022. The Plan outlines measures for prevention and response, which have been implemented, with the support of the multi-sectoral National Committee for

the Fight against Avian Influenza, which oversees the coordination of interventions and the monitoring and evaluation of guidelines, advocacy, and resource mobilization. The committee includes representatives from the General Secretariat of the Government, the Ministry in charge of Animal Production and Fisheries Resources, Ministry of Interior, Ministry of Health and the Ministry of Environment and Water and Forestry.

Table.
Measures outlined by HPAI National Plan

PREVENTION	RESPONSE
<ul style="list-style-type: none"> - Reinforcement of biosecurity measures at the level of the different links in the value chain (training, capacity building of actors) - Simulation exercises - Strengthening of the laboratory's analytical capacities (e.g. equipment, reagents) through USAID funding (FAO/ECTAD) - Capacity building of veterinary services 	<ul style="list-style-type: none"> - Early detection - Stamping out in the protection area - Surveillance in the surveillance area - Risk communication - Compensation to breeders

SURVEILLANCE

Passive and active surveillance are conducted for HPAI. Scheduled surveillance is conducted on breeding farms and at markets based on the previously established risk mapping that allowed for identification of the 26 areas at high risk of introduction and spread of HPAI viruses. Through a Ministerial decree under the Ministry of Animal Resources and Fisheries and establishment with the DVS, 10 poultry Sanitary Defense Groups have been created for community surveillance, informed by stakeholders, to conduct active surveillance. Funding is supplied via the interprofessional fund for Agricultural Research and Council (FIRCA) and the FAO, and operations are supported via the Ivorian Poultry Interprofession. The territorial administration authorizes the creation of each Sanitary Defense Group. A nationwide sensitization of health defense groups for poultry and poultry farmers to strengthen biosecurity measures, disease surveillance, and real-time reporting in poultry farms and markets was conducted in 2021, with support from FAO, USAID, and the Ivorian Poultry Interprofession.

PREVENTION AND CONTROL MEASURES

Prevention is based on training and broadcasting biosecurity and biosafety guideline, HPAI disease epidemiology and risk of transmission, and regulations about measures to be taken (e.g. distancing between infected farms). Samples are taken and sent to the National Laboratory for Agricultural Development (LANADA) for analysis, and any positive cases are reported to WOA. When a case is detected, national and local control committees are reactivated, risk communication is conducted, sanitation measures are applied (e.g. stamping out 600,000 poultry in 2021 proximal to the outbreak), control of poultry movements and products is reinforced, and farmers are compensated for their losses. During the 2021 outbreak, an epidemiological investigation was

conducted by a joint team (Veterinary Services, Veterinary Services of the Armed Forces, and Water and Forestry Agents), which sampled resting areas of migratory birds with epidemiological links to the outbreaks. The public health sector also investigates humans at risk. The results of these analyses were all negative. FAO-ECTAD in Côte d'Ivoire assisted the government in conducting surveys and strengthening the capacity of the national laboratory through provision of personal protective equipment (PPE), disinfectants, reagents, and consumables from FAO's emergency stockpile and the online ordering service for primers and probes set up by FAO headquarters.

REGIONAL CONSIDERATIONS

Since 2021, HPAI has been circulating in West Africa, in wild birds and laying poultry in Senegal, Mauritania, Mali, Togo, and Ghana. Cases have been reported in 2022 in Burkina Faso and Senegal. Porous borders, inadequate biosecurity, and illegal trade between neighboring states are among risk factors for the spread of the virus in the subregion. Although a sub-regional strategy to fight HPAI exists, it is not being implemented. In 2016, when the disease emerged, a workshop was held in Abidjan to discuss the situation but there was not yet support for logistics and diagnostic; only meetings but no operational support. Since 2021, with the finding of HPAI-linked deaths in wildlife (e.g. white pelicans), a more formal task force is being formed to take action. The FAO-ECTAD Regional Office for West and Central Africa supported the recently established Regional Incident Coordination Group for West Africa on HPAI under the leadership of the Economic Community of West African States (ECOWAS) Regional Animal Health Centre (RAHC); in 2021 the first virtual meeting was held, with participation from the 15 West African countries. FAO-ECTAD supported management of avian mortality events caused by HPAI in 2021, as well as countries at risk through regional coordination.

Highly Pathogenic Avian Influenza

IMPLEMENTATION GAPS

The implementation of prevention and control plans faces challenges:

- Decentralized administrations have insufficient means for travel and sampling equipment, and many agents in these administrations have not received additional training in field epidemiology
- Low biosecurity on the farms and in live poultry markets
- Community surveillance based on the Sanitary Defense Groups (and thus first-line detection and early alerts) is not fully operational, hindered by lack of financial resources and technical means (e.g. fuel to deploy teams, a single veterinarian)
- Lack of means to implement active surveillance; including delays in sample processing (e.g. nearly 40% of laboratory results were sent over 48 hours after sample submission), sequencing capacities not operational, and frequent reagent shortages affecting the virology laboratory
- Inadequate preparedness in decentralized administrations, affecting response
- Recurrent challenges to implementing quarantine during outbreaks, including movement of animals by some farmers when the disease is suspected
- Delays in financing for control and farmer compensation
- Lack of concrete and concerted regional actions for the control of HPAI

KEY RECOMMENDATIONS

- Set up a response funding mechanism with the Poultry Interprofession to enhance sampling (e.g. from day-old chicks) and enable compensation of breeders for losses
- Strengthen capacities of the various stakeholders (environment, animal health, human health, laboratory, and Sanitary Defense Groups) for early detection, in particular training agents in field epidemiology and equipping poultry breeding stations.
- Enhance migratory bird surveillance
- Improve knowledge on animal mobility to inform risk assessment
- Establish a rapid transport system for samples
- Conduct simulation exercises at regional level, hold after-action reviews, strengthen veterinary services, and establish and train regional response units
- Implement a subregional control plan, with cross-border meetings, reference laboratories to conduct phylogeny characterization analyses to improve strain tracking, a regional intervention center capable of providing real-time support, and harmonizing legislation on prevention, detection, and response to epizootics

Mali



Completed Assessments and Plans

JEE	PVS Evaluation	PVS Evaluation Follow-Up	PVS Gap Analysis	PVS Legislation	IHR-PVS Bridging Workshop	NAPHS	OHZDP	National AMR Action Plan	NBSAP
2017	2007	2017	2009	2011	2020	2020	2017	2019	2015

Indicator	Country	Region Average	Continent Average
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Coordination and Financing

Multi-sector and One Health collaboration/coordination for AMR (1-5)	—	2.20	2.44
Collaborative effort on activities to address zoonoses (0-100)	80.00	55.00	54.23
Current health expenditure per capita (USD)	34.28	58.69	132.25
CFE disbursements (USD)	0.00	2,361,848.00	4,903,032.44

Workforce

Veterinarians (total)	1,525.00	909.00	3,512.00
Veterinarians (per 1,000 people)	0.08	0.08	0.17
Public animal health professionals (total)	22.00	52.00	461.00
Public animal health professionals (per 1,000 people)	0.00	0.01	0.02
Medical doctors (total)	2,454.00	5,967.00	8,574.00
Medical doctors (per 1,000 people)	0.13	0.17	0.41
Up-to-date multisectoral workforce strategy (1-5)	2.00	2.03	2.19
Progress with strengthening veterinary services (1-5)	—	2.80	2.80

Demographic Factors

Population (total)	19,658,023.00	24,464,630.38	24,185,802.76
Population growth (% , 2010-2019)	30.60	27.01	23.73
GNI per capita (USD)	870.00	1,335.62	2,525.37

Environmental and Sanitation Factors

Land area (sq km)	1,220,190.00	378,979.38	548,414.71
Arable land (% land area)	5.25	19.19	14.14
Forest area (% land area)	10.90	27.66	27.57
Terrestrial protected areas (% land area)	8.23	15.52	16.27
Average primary forest loss (ha)	—	6,105.65	20,326.14
Access to basic drinking water — rural (%)	68.30	56.77	55.48
Access to basic drinking water — national (%)	78.30	69.53	69.76
Access to basic hygiene — national (%)	52.20	21.94	26.71
Access to basic sanitation — national (%)	39.30	30.23	40.71

Animal Factors

Average livestock stocks (LSUs)	10,177,736.66	4,615,777.30	5,551,123.37
Average livestock exports (LSUs)	175,874.62	20,487.72	33,314.93
Average livestock imports (LSUs)	21,604.54	36,990.70	31,044.50
Mammal species (number)	214.00	230.06	241.65

STATUS OF ONE HEALTH AND VETERINARY SYSTEMS

The Central Veterinary Laboratory, the National Directorate of Animal Production and Industries (DNPIA), and the National Directorate of Veterinary Services (DNSV) are housed within the Ministry of Rural Development. The National Directorate of Veterinary Services (DNSV) is decentralized and is tasked with the fields of animal health and veterinary public health. Its key priorities are related to animal protection and veterinary public health, comprising: policy development, implementation, and enforcement; development of disease control programs; development of standards; strengthening veterinary infrastructure and centralizing and dissemination information and data. The sub-national Veterinary Services are responsible for surveillance through EPIVET, disease prevention, control and response.

The Malian government has delegated some of the activities of veterinary services to private professionals, in particular veterinarians holding a health mandate (VTMS), distributors of veterinary medicines, and owners of veterinary clinics and practices. They are organized into a national association of veterinary surgeons (ANAVEM), a collective of veterinary surgeons (COVEM), and a national network of veterinary practices and clinics (RENAVET) and carry out their activities under the supervision of the veterinary services. Pharmaceutical distributors are organized into a group of veterinary wholesalers. The veterinary agents are responsible for the health of domestic animals through the national programs for the control of animal diseases.

The Ministry of Health and Social Development oversees human health via the Health and Public Hygiene Branch, the National Institute of Public Health (INSP) and the Public Health Emergency Operations Department. The National Institute of Public Health (INSP) was established in 2019, a key objective under

Mali's Global Health Security Agenda (GHSA), and combines several former research structures within the Ministry of Health (e.g. the National Institute of Public Health Research (INRSP), the Research and Documentation Center for Child Survival (CREDOS), the National Food Safety Agency (ANSSA) and the National Center for Disease Control Support (CNAM), which includes autonomous units such as the Vaccine Development Center (CVD), the Influenza Center, the Pharmacovigilance Center and the Department of Emergency Operations (DOUSP)). A particular aim is to coordination of national surveillance and response interventions; implementation of public health strategies; vaccinology; reference laboratories; health stockpiles; promote medical and pharmaceutical research; and promote national and international cooperation in research, training, and disease control. The Centers for Public Health Emergency Operations (COUSP) was established with technical assistance from the U.S. CDC to test, detect, and respond rapidly to public health emergencies. Suspected case reports and laboratory data from sub-national jurisdictions can now be integrated into Mali's national database to support early detection and responses to epidemic-prone diseases.

The Ministry of Agriculture, Livestock and Fisheries (MAEP) is responsible for promoting an attractive rural environment and sustainable agriculture, contributing significantly to accelerated growth for rural poverty reduction and ensuring food security and self-sufficiency. It oversees a range of projects related to food security (e.g. locust control, access to water and crop security, livestock and smallholder farming, and livestock breeding). The Ministry of the Environment, Sanitation and Sustainable Development is responsible for addressing climate change, and has entrusted the Sustainable Development Agency (AEDD), created in 2010, with the mission of managing the various aspects of climate change. Wildlife habitat and hunting management are under the control of Waters and Forests (Ministry of the Environment). Wildlife health and national parks are under the control of the veterinary services (currently the Ministry of Rural Development).

SWOT ANALYSIS | MALI

S

STRENGTHS

Formal One Health platform exists

Political willingness and commitment to invest in One Health

Existing technical structures throughout the country

Veterinary legislation is available

Technical and financial partners

Engagement of private sector veterinarians

Houses WOAH/FAO/AU-IBAR's Regional Animal Health Center

Recent Consensus Roadmap (2016-2019) developed with GHSA support

In-country animal vaccine production

Real-time case reporting system is being tested with the support of FAO (EMA-i or Event Mobile Application)

Presence of veterinary laboratories

Systems in place for systematic, information sharing among ministries

W

WEAKNESSES

Insufficient veterinary staff (less than half of recommended levels)

Insufficient logistical and financial resources

Lack of national databases especially the database of the sanitary situation at the level of the veterinary services.

Limited animal health monitoring capabilities

Public Service Recruitment

Inadequate and mostly dilapidated buildings/facilities

No in-service training or recruitment plan for veterinarians; no continuing education financed by the veterinary services (State)

Lack of permanent funding for One Health platform

Lack of resources for EPIVET Network for animal surveillance

T

THREATS

Deterioration of the security situation and withdrawal of technical and financial partners.

Instability of human resources for various reasons (e.g. no career openings; poor public awareness, NGOs and private sector more attractive); resultingly, public veterinary sector seen as unattractive

Low recruitment and closure of some posts

Insignificant technical means

Continuous training heavily reliant on external support

Reliance on private veterinarians out of insufficient support for Veterinary Services

Lack of staff and resources prevents EPIVET-Mali network to be efficient

O

OPPORTUNITIES

Government subsidizes vaccines

Engagement of private veterinary professionals in provision of care

National network of veterinary practices and clinics

Continuous training opportunities through international collaborations

Engagement of the public sector and the army in veterinary capacity building

Established zoonotic disease surveillance systems and EPIVET-Mali network

Relevant projects and programs in Mali are mainly financed by the German Federal Ministry for Economic Cooperation and Development, the German Federal Foreign Office and the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, World Bank, the African Development Bank, the Islamic Development Bank, the ECOWAS network, FAO and the World Food Program; and the technical and international cooperation of Switzerland, Belgium, Germany, France, the United States of America, Canada, and Japan.

As of 2020, the national budget allocated to the DNSV and the DRSVs (Direction Régionale des Services Vétérinaires) increased by 8% compared to 2019, to FCFA 2.09 billion (approximately \$3.2 million). Key expenditures include salaries, capital, routine maintenance of buildings, expenditure on equipment and operation of services, fuel, technical supplies, transportation costs, maintenance of computer equipment, maintenance and repair of vehicles. There are no state subsidies for private veterinarians that carry out vaccination campaigns.

Mali joined the International Health Partnership+ (IHP+) in 2009, with a ten-year health and social development plan (PRODESS; Plan Décennal de Développement Sanitaire et Social, 2014-2023). The plan was signed by the Ministry of Health and eighteen development partners in 2009. Mali is also part of the West African Network of Biomedical Analysis Laboratories (RESAOLAB).

Bamako houses the first Regional Animal Health Center, managed through WOAHA, FAO, and AU-IBAR, which coordinates and harmonizes monitoring and evaluation of avian influenza and other animal disease activities in the region. In 2011, the President of Mali and the Director General of WOAHA inaugurated a new building for the WOAHA Regional Representation for Africa, also located in Bamako, financed entirely by the Government

of Mali at a cost of 140 million CFA francs (approximately \$214,200).

One Health Coordination

In response to findings from the Joint External Evaluation (JEE) in 2017, a decree establishing the creation, responsibilities, and operation of the One Health National Platform in Mali was signed by the Prime Minister in April 2018. The Platform was launched by the U.S. government through USAID and the Malian government. Specific activities under the One Health platform include training nurses and hospital staff in infection control measures, investing in the nationwide roll-out of the District Health Information System surveillance system, conducting cross-border emergency preparedness exercises, procuring laboratory equipment and supplies, and supporting the development of multi-sectoral standard operating procedures to control zoonotic disease outbreaks. To date, no evaluation has been conducted to assess the implementation status or success of these multisectoral efforts (medical, animal and environmental health engagement). The One Health Platform is not involved in the vaccination campaign at this time.

The One Health Platform coordinates all One Health activities in Mali and defines leadership roles for the Ministries of Health, Livestock, Environment and Agriculture, and support roles for six other ministries, including the Ministry of Defense and Veterans Affairs and the National Directorate of Water and Forests (DNEF). The platform constitutes a framework for periodic quarterly and annual meetings with stakeholders. With support of the Global Health Security Program Implementation fund, Mali developed a consensus roadmap for 2016-2019. The shortcomings of the platform have been identified as a lack of permanent funding and poor involvement of the various stakeholders. Currently, activities are limited to training and brainstorming workshops. Efforts have been supported by Agronomists and Veterinarians Without Borders, who have led participatory workshops with farmers' organizations.

Training Pipelines

Mali does not have a veterinary school in country, but is part of the Ecole Inter - Etats des Sciences et Médecine Vétérinaires (EISMV) network, providing access to a veterinary training pipeline. The Institut Polytechnique Rural de Formation et Recherche appliquée (IFRA) also provides training on relevant topics. Continuing education programs are planned in the fields of veterinary public health and zoonoses control in animal populations, as well as field epidemiology. Currently, there is no training plan for veterinarians or a recruitment plan, though a training plan was being developed and financed by the World Bank regional support project for pastoralism in the Sahel (PRAPS). The lack of continuous training for agents is reported as

a difficulty by the DNSV in its 2021 annual report. Two types of training exist at the level of veterinary services: pre-service training and continuous training.

Continuous training is financed by projects and programs and by technical and financial partners. Mali is part of the frontline training in applied veterinary epidemiology (ISAVET) program, run through FAO and partners, which aims to provide animal health workers with disease detection and response skills to reduce risks and impacts. In addition, with the support of U.S. CDC, the Ministry of Health launched Mali's Field Epidemiology Training Program (FETP) in 2016, beginning with the three-month Frontline Training program targeting local Ministry of Health staff. AFENET is a partner on the FETP program in Mali. The trainees and graduates have supported investigation

Box. Recent training initiatives (examples)

Rapid response: Through U.S. CDC support, 28 rapid response teams were trained in public health emergency investigation and management, reaching subnational levels (including 49 districts). Laboratory screening was enhanced, with 7 regional and 7 national laboratories equipped to perform diagnostic tests for 13 priority pathogens.

AMR: Hospital-based Laboratory were trained in bacterial identification and sensitivity testing by the National Institute of Public Health Research.

Veterinary Civic Action Project (VETCAP): In 2020, the Civil Military Support Element (CMSE) of the U.S. Embassy in Bamako partnered with the National Directorate of Veterinary Services (DNSV), USAID, Catholic Relief Services and the International Livestock Research Institute (ILRI) to provide training for Malian veterinarians working with livestock. A key focus was on veterinary care and animal disease prevention in rural areas. Supplies and instruments to send biopsies to the CVL were provided to trainees. A total of 25 veterinarians were trained from 6 districts.

Economics of Land Degradation (ELD) initiative: under the framework of the Regreening Africa project and in collaboration with the World Agroforestry Center (ICRAF), the initiative organizes training courses on the economic valuation of terrestrial ecosystems and their services, supporting more comprehensive estimates. Practical exercises complement the training, tailored to in-country research.

The Swiss Tropical and Public Health Institute works with national and international partners in Chad, Mali and Mauritania on interdisciplinary research and action related to health interventions in nomadic pastoralist environments.

and response to Rift Valley fever, measles, meningitis, polio, yellow fever and rabies events.

DISEASE MANAGEMENT

Surveillance and Reporting

The National Directorate of Veterinary Services (DNSV), the Central Veterinary Laboratory (LCV), the National Animal Health Support Center (CNASA), private veterinarians, public health doctors, the epidemiological surveillance network (EPIVET), local authorities and other civil society actors contribute to the surveillance and reporting of diseases through various communication channels and notification systems.

The EPIVET MALI epidemiological surveillance network is a permanent system within the Ministry of Livestock and Fisheries and oversees animal surveillance. The WOAHA focal point for Wildlife, who is based in the DNSV, contributes to wildlife surveillance reporting process. Surveillance at the slaughterhouses and at the points of entry is conducted by the DRSV officers, who are assigned to slaughterhouses and veterinary stations. The network targets a list of key diseases (six of which are zoonotic): rinderpest, CBPP, foot and mouth disease (FMD), Rift Valley fever, brucellosis, tuberculosis, rabies, avian influenza, Newcastle disease, anthrax, and animal trypanosomiasis. In 2019, a decree established its mission and organization, with a steering committee, technical coordination committee, the central unit, regional units, surveillance posts, and other stakeholders (such as groups of animal breeders). While country has well-established zoonotic disease surveillance systems, a lack of staff and resources prevents them from being fully implemented. As a result, the EPIVET-Mali network is very weak, if not ineffective in meeting its objectives.

In collaboration with the Vaccine Development Center, influenza surveillance is conducted at sentinel sites in two regions and in the capital, Bamako. The U.S. CDC has been working with the Center for Vaccine Development in Mali to strengthen surveillance and laboratory capacity to prevent, detect and respond to influenza threats.

Different agencies exchange information and situation reports on possible epidemics. Joint investigation missions are organized in case of a zoonotic outbreak. There are also informal links between public health and animal health laboratories for sharing of samples and reports. Positive results obtained by the CVL and reports from zoonotic disease surveillance systems are forwarded by the National Veterinary Directorate to the relevant departments of the various ministries (Ministry of Health, Ministry of Environment, and Ministry of Rural Development). A computerized real-time case reporting system is being tested with the support of FAO (the Event Mobile Application, or EMA-i). In addition, the National Center for Information, Education and Communication for Health (CNIECS) is responsible for the coordination of national communication activities. In a crisis, the Center manages information in collaboration with the technical services and the communication adviser from the Ministry of Health. Additionally, Mali's Public Health Emergency Operations Center (PHEOC) supports surveillance and control in disease events, and has developed stronger links with the National Institute of Public Health (which conducts long-term infection monitoring, control, and prevention).

Despite the existence of reporting across agencies, external reporting may be more limited. For instance, the only event reported on Mali in the Program for Monitoring Emerging Diseases (ProMED), an online outbreak reporting system, was in 2018 for rabies awareness and free vaccination.



- High livestock ownership, with camels in the north and poultry in the south
- Environmental crises, instability, and conflict affect movement of people and animals (congregating for grazing and water resources; limited access to markets and services)
- Major gold producer and high participation in cotton farming
- High seropositivity rates for MERS-CoV (or related viruses) detected in dromedary camels
- Very limited remaining forest area, but rosewood trade continues
- Depletion of inland fish stocks in Niger Delta and desertification of verdant flood plains
- High rates of acute malnutrition (particularly in north and central areas) and reliance on humanitarian assistance exacerbated by drought conditions and flooding

Access to Diagnostics and Vaccines

Diagnostics

The national laboratory system includes laboratories in the health, livestock, and higher education sectors, as well as private laboratories. These laboratories are distributed across three levels of the public health system: central (6 laboratories belonging to research institutes, 5 laboratories of national hospitals, the central veterinary laboratory), regional (6 laboratories of public hospitals) and peripheral (65 laboratories of reference health centers and 80 community health centers). The national laboratory network conducts integrated disease surveillance and rapid confirmation of outbreaks. Peripheral laboratories can perform key tests for HIV, tuberculosis, malaria and cholera. Diagnostic algorithms have also been developed for confirmation of priority diseases.

There are three public veterinary laboratories in Mali: in Kayes, Gao, and the Central Veterinary Laboratory (CVL) in Bamako. The CVL uses the international reference laboratories of WOAHP or the FAO for confirmation of select diseases (e.g. avian influenza, FMD, and rabies), including through CIRAD in France, AIEA in Austria, and the Padova laboratory in Italy. The country also has a high biological security laboratory (P3) at the Faculty of Medicine in Bamako for the

diagnosis of viral hemorrhagic fevers. The central veterinary laboratory has several departments with the capacity to detect the main zoonoses with epidemic potential as well as a Medical Bacteriology laboratory capable of detecting antimicrobial resistant pathogens.

Vaccination

The CVL produces vaccines against PPR, CBPP, Clavelée, Newcastle disease, nodular bovine dermatosis, Anthrax, symptomatic anthrax, and both bovine and ovine pasteurellosis. Human vaccines (e.g. measles, meningitis, covid) are also purchased in Copenhagen via UNICEF supply chain and co-financing of the purchase of vaccines by the country and the technical and financial partners (GAVI, UNICEF). In 2001, a formal agreement was signed between Mali's Ministry of Health and the Center for Vaccine Development (CVD) at the University of Maryland, establishing a unit in Mali intended to quantify vaccine-preventable diseases, test the safety, immunogenicity, and efficacy of relevant new vaccines, and train Malian vaccinologists.

PREVENTION AND CONTROL MEASURES

Mali has identified 6 priority zoonoses: anthrax, bovine tuberculosis, rabies, viral hemorrhagic fevers (including Crimean-Congo hemorrhagic fever, Ebola, Lassa,

Marburg, Rift Valley fever, yellow fever) and avian (zoonotic) influenza.

In 2017, following national stakeholder workshops, representatives of the Ministries of Health and Livestock and nomadic communities identified joint vaccination campaigns as the priority action. A One Health approach to vaccination was taken up; mobile veterinary infrastructure was strengthened to support simultaneous vaccination of people and animals in nine of the 29 vaccination rounds. Campaigns were implemented with local health and veterinary staff to avoid parallel structures and to use all existing infrastructure (cold chain and transport).

The government, through the DNSV, coordinates annual livestock vaccination campaigns (PPR, CBPP and Pasteurellosis); the vaccine is subsidized by the state, but vaccination is carried out by private veterinarians. The country has a national immunization program and plan (EPI), aligned with the WHO Global Plan of Action for Vaccines, covering 11 vaccine-preventable diseases. To date, this program does not include zoonotic diseases, although veterinarians

provide vaccination against rabies and anthrax in parallel under their mandates.

The FAO's Emergency Center for Transboundary Animal Diseases (ECTAD) in Mali supported adoption of the National Rabies Control Program in Mali (2019-2023) in September 2018, based on the One Health approach.

A national action plan (NAP) for the fight against antimicrobial resistance (AMR) in Mali (2019-2023) has been developed and validated technically, but not politically, which means that it is not yet operational. From the conclusions and recommendations of this AMR consultation, technical groups have been set up and sectoral focal points have also been designated. The situational analysis made it possible to identify shortcomings translated into strategic interventions, from which the main activities of the plan are derived.

ETHICS

Currently, there is a national animal welfare ethics committee.

Box. Initiatives and Projects in Mali (examples)

Mobile infrastructure: Fondation Mérieux provided a mobile laboratory in Mali, and through support from EU humanitarian aid, Save the Children set up a mobile clinic, intended to provide care to vulnerable people.

Conservation: Mali was among countries selected under the Global Environment Facility (GEF) \$40 million funding for the Global Wildlife Program (GWP) in 2016, to support action on illegal trafficking in 19 countries. Under this funding, in 2018 the "Community-based Natural Resource Management that Resolves Conflict, Improves Livelihoods and Restores Ecosystems across the Elephant Range" project was launched in the Lake Banzena Protected Area in the Gourma Reserve through a partnership between the Ministry of Environment, Sanitation and Sustainable Development (MESSD) and the GEF. The project is being implemented by the United Nations Development Program (UNDP).

MALI CASE STUDY:

Taeniasis/Neurocysticercosis

CURRENT SITUATION

Taeniasis refers to intestinal infection by tapeworms. Three species of parasites cause taeniasis in humans (*Taenia solium*, *Taenia saginata*, and *Taenia asiatica*); however, only *T. solium* is linked to significant human health problems. *T. saginata* causes substantial economic losses in the livestock sector through impacts on infected beef carcasses. Humans are infected with *T. solium* via ingestion of cysticerci (larval cysts of the parasite) in infected, undercooked pork. In turn, infected persons excrete tapeworm eggs in their feces and can contaminate the environment through open defecation. Taeniasis and neurocysticercosis present a major public health problem in developing settings, particularly where pig and wild boar consumption is common and improved sanitation is lacking. *T. solium* is a neglected zoonotic parasite that causes epilepsy and severe headache among other disease burden in humans; the condition is termed neurocysticercosis. Infestation of pigs causes substantial economic losses to pig farmers in endemic areas.

In Mali, where more than 90% of the population is Muslim, neurocysticercosis is not recognized as a zoonotic risk, as *T. solium* has pigs as an intermediate host and their meat is not widely consumed by this population. However, taeniasis/cysticercosis is a serious public health problem in other populations in the region, particularly in areas with inadequate water, sanitation, and hygiene. In Mali, pig farming is conducted by the Bwa ethnic group, with farms located in the central part of the country (Segou region). In 2009, a case of neurocysticercosis was reported at the Gabriel-Touré University Hospital (CHU) in Bamako in a 24-year-old girl.

HIGH-LEVEL STRATEGIES

No control, surveillance or prevention strategies for taeniasis and neurocysticercosis are in place in Mali.

SURVEILLANCE

No surveillance strategy for taeniasis and neurocysticercosis is in place. In Bamako, the “Sans-fil”

slaughterhouse does not slaughter any pigs, and the Sabalibougou slaughterhouse does not have appropriate slaughter facilities but allows inspection. No national data on taeniasis and human (neuro) cysticercosis exist in Mali; without epidemiological data, control measures cannot be informed. There is no data on the prevalence of *T. solium* infestation in wild and domestic Suidae, nor on *T. saginata* in domestic and wild Bovidae and Ungulates.

PREVENTION AND CONTROL

There is no national program, despite a rising number of pigs (approximately 86,000) and a high prevalence of epilepsy in the country. The portion of epilepsy cases in the country linked to this cause is not known. No preventive measures are taken. Areas considered at risk are in the Segou region (Bla, San, and Tominian) and the Mopti region (Badiangara, Koro), which have pig breeding and pork consumption.

Taeniasis/Neurocysticercosis

REGIONAL CONSIDERATIONS

Neurocysticercosis ranks first on the global scale of foodborne parasitosis by the FAO and WHO, and is one of the neglected zoonoses targeted for control, elimination, and eventual eradication (as confirmed by the World Health Assembly in 2013). Epidemiologically, there is limited understanding; with poor data availability on prevalence in pigs and humans in West Africa. At present, no international collaboration or NGO is addressing this topic in Mali. Along borders, veterinary posts have authority for animal health, but there is typically no import or export of pigs or pork meat in Mali.

IMPLEMENTATION GAPS

Neurocysticercosis is a neglected disease. The main gap is funding and reliable data on the prevalence and incidence of taeniasis and neurocysticercosis in humans and infestation of domestic and wild Suids and Ungulates. The gaps in risk coverage are:

- Incomplete epidemiological data at national and regional levels.
- The absence of pork slaughter in certified slaughterhouses due to the lack of appropriate infrastructure and lack of sanitary surveillance
- Lack of willingness to implement a diagnostic, surveillance, prevention, and control program
- Lack of a communication program (a public health issue not felt by the community)
- Lack of funding and interest

KEY RECOMMENDATIONS

- Establish mechanisms of coordination, research, communication and collaboration between the veterinary and human health sectors through a One Health approach
- Evaluate the epidemiological situation and take stock of study findings, including via pilot studies to establish the status and prevalence of taeniasis in livestock, especially in slaughterhouses, to allow more precise mapping of areas at risk
- Draft and implement a national control program in areas at risk, including via regulation of pig slaughtering in abattoirs and systematic health surveillance
- Investigate (and treat) cysticercosis in cases of epilepsy, potentially in coordination with the newly created National League against Epilepsy in Mali
- Develop diagnostic, surveillance, prevention, outreach and control programs

Senegal



Completed Assessments and Plans

JEE	PVS Evaluation	PVS Evaluation Follow-Up	PVS Gap Analysis	PVS Legislation	IHR-PVS Bridging Workshop	NAPHS	OHZDP	National AMR Action Plan	NBSAP
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Workforce			
Veterinarians (total)	1,459.00	909.00	3,512.00
Veterinarians (per 1,000 people)	0.09	0.08	0.17
Public animal health professionals (total)	50.00	52.00	461.00
Public animal health professionals (per 1,000 people)	0.00	0.01	0.02
Medical doctors (total)	1,435.00	5,967.00	8,574.00
Medical doctors (per 1,000 people)	0.09	0.17	0.41
Up-to-date multisectoral workforce strategy (1-5)	2.00	2.03	2.19
Progress with strengthening veterinary services (1-5)	—	2.80	2.80
Demographic Factors			
Population (total)	16,296,362.00	24,464,630.38	24,185,802.76
Population growth (% ,2010-2019)	28.50	27.01	23.73
GNI per capita (USD)	1,430.00	1,335.62	2,525.37
Environmental and Sanitation Factors			
Land area (sq km)	192,530.00	378,979.38	548,414.71
Arable land (% land area)	16.62	19.19	14.14
Forest area (% land area)	42.11	27.66	27.57
Terrestrial protected areas (% land area)	25.35	15.52	16.27
Average primary forest loss (ha)	0.41	6,105.65	20,326.14
Access to basic drinking water — rural (%)	70.50	56.77	55.48
Access to basic drinking water — national (%)	80.70	69.53	69.76
Access to basic hygiene — national (%)	24.10	21.94	26.71
Access to basic sanitation — national (%)	51.50	30.23	40.71
Animal Factors			
Average livestock stocks (LSUs)	3,570,874.30	4,615,777.30	5,551,123.37
Average livestock exports (LSUs)	845.71	20,487.72	33,314.93
Average livestock imports (LSUs)	128,654.95	36,990.70	31,044.50
Mammal species (number)	257.00	230.06	241.65

STATUS OF ONE HEALTH AND VETERINARY SYSTEMS

Senegal is divided into 14 regions, with 45 departments and 113 districts. The Directorate of Veterinary Services (DSV) is part of the Ministry of Livestock and Animal Production (MEPA). The DSV has a mandate for animal health, veterinary public health, and oversight of the veterinary profession. The DSV develops and implements relevant laws and regulations, including on pharmaceuticals and food safety, animal health, and veterinary functions. In collaboration with the Livestock Directorate, the DSV is concerned with the quality of animal feed; national, regional, and global specialized agencies in animal health and veterinary public health; and import and export veterinary certification of animals and animal products. Organization of the DSV and livestock services follow a pyramid structure, with ministry offices at the central level, regional service centers at the regional level, district service centers, and peripheral-level veterinary posts.

The regional service centers have a veterinary surgeon. Apart from government service centers, there are private veterinarians in some districts. Where private veterinary services are available, the government veterinarian in the regional offices limits activities to administrative affairs alone. Veterinary posts are staffed by livestock agents supported by livestock assistants from the One Health Task Force Steering Committee. The livestock agents are paraprofessionals with a 2-year training. District centers are managed by livestock engineers who are also paraprofessionals with a high school diploma and a 3-year training. Veterinarians are focal points for all activities recommended by WOA. The WOA National Focal Points for Wildlife and Aquatic Animals are under the authority of the Ministry of Environment and Sustainable Development and the Ministry of Fisheries and Maritime Economy, respectively.

Senegal is a member of the Global Health Security Agenda, through which it has reinforced at global level the need for community engagement in prevention, detection, and response efforts. The One Health Task Force has a Multisectoral Technical Committee responsible for the following:

- Developing multisectoral plans for the Global Health Security Program
- Ensuring the coordination and monitoring of the multisectoral response of any international or national human and animal health event and environmental event with the affected sectors
- Sharing the thematic groups' conclusions to monitor the implementation of the steering committee's directives and recommendations to help build capacity and disseminate the One Health approach to Global Health Security

An Emergency Operations Center (EOC) was created in 2014 in response to Ebola (an imported case from Guinea). The Ministry of Health and Social Action (MSAS) has established a surveillance program at all borders. Senegal has extensive experience in the multisectoral management of major health crises. Multisectoral emergency plans utilize the mechanisms and means of the National Disaster Relief Plan (the "ORSEC" plan), which is authorized and supervised by the Prime Minister's office.

The National Parks Directorate (DPN) and the Directorate of Community Marine Protected Areas, under the Ministry of Environment and Sustainable Development (MEDD), are tasked with ecosystem management. Recruitment of national parks personnel is open to veterinary professionals. The parks and reserves are managed by the Ministry of the Environment. Under the supervision of the Ministry, the Directorate of Water and Forests, Hunting and Soil Conservation is responsible for national forestry policy, including on soil conservation, wildlife management and forest ecosystems. The Water and Forests Directorate focus on issues related to poaching of fauna and flora, and is increasingly engaging in One Health and health

SWOT ANALYSIS | SENEGAL

S

STRENGTHS

Political will to develop the One Health sector and veterinary capacities in the country (priority in the economic and social development policy)

One Health platform approved by prime minister

Coverage of livestock services at central, regional, departmental, and rural community levels

Strong institutions for teaching in animal sciences and veterinary medicine, as well as veterinary and zootechnical research

Passive wildlife surveillance in protected areas

Veterinarians employed in national parks

Capacity to develop and produce human and animal vaccines (e.g. COVID)

Strong engagement of private veterinarians

W

WEAKNESSES

Regional laboratories are not functional (e.g. limited personnel and equipment)

Guidelines for activities under One Health platform do not exist

One Health activities have yet to be implemented at sub-national levels

Not enough resources for public veterinarians to carry out mandate and so reliance on private veterinarians

Limited sub-national veterinary capacity

No budget for wildlife disease systems

No dedicated early warning systems for health and environmental emergencies

Privatization of the distribution chain of veterinary products

No coordination mechanism between national IHR and WOH focal points and other sectors

Field veterinarians in protected areas and reserves lack specific sampling guidelines

O

OPPORTUNITIES

Availability of specialized Master's programs

Strong veterinary training program (EISMV) serving Francophone nations could be further leveraged (e.g. in-service, collaborations with international agencies)

Strong link to international institutions

The One Health national coordination platform has designated financial/human resources

External projects take into account the country needs and priorities

Included in a project of WOH to develop OH curricula in the region

T

THREATS

Compensation for farmers during an outbreak is not guaranteed

Limited or no financial incentives to engage private veterinarians in vaccination campaigns

Lack of governmental funding and logistical support to health staff in rural areas

Importation of veterinary products with poor quality control

security activities based on disease emergence concerns. The National Biodiversity Information System (SEN BIO- INFOS), which is funded through the EU, chairs the National Biodiversity Committee, supports technical and scientific collaboration, and implements activities related to biodiversity in Senegal.

Changes to Senegal’s legal framework have resulted in changes to the field of veterinary medicine and the importation and distribution of veterinary products. In terms of the veterinary profession, there has been a major increase in the number of private veterinarians and paraprofessionals, resulting from financial mechanisms supported by international organizations. In 1990 the International Monetary Fund and the World Bank requested that no more veterinarians be recruited into the civil service as part of a structural adjustment program, without building in a mechanism to offset impacts on the veterinary workforce. Veterinarians receiving training abroad were left without prospects in the civil service, resulting in a supply of private veterinarians. As a result, the veterinary services ended up delegating certain positions, effectively privatizing some functions, particularly related to the distribution of veterinary products. Previously, the state had central offices, but from the 1990’s the state was forced to give health mandates to private veterinarians. The Pan-African Programme for the Control of Epizootics (PACE) under AU-IBAR collaborated with states to help veterinarians serve these mandates, including setting them up in private clinics and organizing the distribution of drugs. States have recruited private veterinarians to carry out vaccination campaigns; PACE allocated 10 million CFA francs (\$15,200) and encouraged veterinarians to serve rural areas to improve geographical coverage. However, accompanying measures have lagged in relation to veterinary product importation and quality control.

The Senegalese government is responsible for prophylaxis, mandatory inspection, and health security of animal products and animal services; these also extend to private veterinarians under a sanitary mandate. Private veterinarians regularly participate and complement public veterinary services, especially during state vaccination campaigns when veterinary service agents do not have the material resources for field activities to fulfill their mandate or have limited human resources. The private veterinary workforce, under the scope of the sanitary mandate, assist the State in organizing livestock vaccination campaigns country-wide, but their efforts are limited by a lack of funds and insufficient logistical support. Activities carried out by licensed private veterinarians are remunerated by the State and by farmers. Additional regulations are in place around the establishment of the College of Veterinary Surgeons of Senegal, the Animal Health Law, and the Code of Ethics for Veterinary Medicine.

One Health Coordination

Following approval from the Prime Minister, Senegal established a legal structure for a National One Health platform in 2018. Led by the Prime Minister’s Office, the One Health platform is responsible for intersectoral coordination, development of the national strategy for One Health implementation, and other related guidelines. The One Health Task Force serves as its main technical body.

The Ministries of Health, Livestock, Environment, Home Affairs, Education, and Gender are involved in the One Health Task Force and the platform. The One Health Task Force is currently preparing for the national implementation of One Health. National strategic plans and guidelines for activities are not yet developed, and the platform has not yet been extended at sub-national levels.



- Hosts the Niokolo-Koba National Park (NNP), a major refuge of large fauna in the region
- Overharvest of timber is resulting in extensive and rapid loss of forest
- Agriculture and livestock are key economic sectors, though is limited by poor soil
- Among threats to biodiversity are uncontrolled hunting, habitat loss and degradation from livestock overgrazing, and disease
- The construction of boreholes has allowed for changing livestock keeping practices and recent livestock sector expansion
- Traditional fishing is a major source of animal protein and livelihoods; the fisheries sector plays important role in economy and trade, but commercial overharvesting is depleting marine stocks

Training Pipelines

The Interstate School of Veterinary Science and Medicine of Dakar (Ecole Inter-Etats des Sciences et Médecine Vétérinaires, EISMV) serves as a regional veterinary school for Senegal as well as most of the other Francophone countries in Africa.

The National Training Center for Livestock and Animal Industry Technicians (CNFTEIA), the Higher Institute of Agricultural and Rural Training (HIART) and the *Ecole nationale supérieure d'agriculture* (ENSA) have also introduced One Health scope into their curriculum. As a pilot project based at the EISMV, WOAHP has selected Senegal and Togo as pilot countries to review training programs in these schools to identify opportunities for alignment with WOAHP standards. After this pilot phase, harmonization of these curricula is planned in other African countries.

In 2016, experts from the animal, human and environmental sectors (EISMV, ISED, the Prime Minister's Office, Environment School, Directorate of Laboratories, Infectious Diseases Service, FAO, the Ministry of Livestock) agreed to design a One Health training module. A One Health training project is being integrated into the master's in public health program for human, animal, and environmental health workers, with support from the USAID-funded One Health Workforce project and its partners. In 2019, the first edition of the

International University Diploma "Emerging Infections: A "One Health" approach" was launched. This International University Diploma, from the University of Montpellier (Faculty of Medicine), the French Agricultural Research Centre for International Development (CIRAD-UMR ASTRE), and the Interstate School of Veterinary Science and Medicine (EISMV) of Dakar supports the development of specific skills related to the challenges of emerging infections through an integrated human-animal-environment approach.

Senegalese veterinarians benefit from the proximity of EISMV and its faculty; however, few have enrolled in the Master of Veterinary Public Health courses. The DSV could facilitate continuing education programs, both at the executive level and on specific topics in veterinary public health. The Veterinarians Without Borders (VSFs) also provide vaccination training to non-veterinarians to increase overall capacity.

There are approximately 300 epidemiologists in the country who graduated from the Institute of Health and Development (ISED), EpiVac, or the Field Epidemiology Training Program (FETP), a ratio of more than one epidemiologist for every 46,000 people. At the graduate level, the ISED has trained more than 650 students in public health topics and the Master in Public Health, as well as 17 Doctorates in Public Health.

There are a number of One Health academic partners in Senegal, including IRD local and Montpellier, France; CIRAD, Montpellier, France; Institut Pasteur de Dakar; New Mexico State University, Las Cruces, New Mexico;

University of Texas at El Paso, El Paso, Texas; University of Texas Medical Branch, Galveston, Texas;

DISEASE MANAGEMENT

Surveillance and Reporting

The Ministry of Health and Social Action (MSAS) oversees two public health surveillance offices: the Directorate of Prevention and the Center for Health

Box. Training and Research Initiatives in Senegal (examples)

There are a number of One Health academic partners in Senegal, including IRD local and Montpellier, France; CIRAD, Montpellier, France; Institut Pasteur de Dakar; New Mexico State University, Las Cruces, New Mexico; University of Texas at El Paso, El Paso, Texas; University of Texas Medical Branch, Galveston, Texas; National Institute of Public Health Research, Nouakchott, Mauritania; CSRS, Abidjan, Côte d'Ivoire; Swiss Tropical and Public Health Institute, and the University of California-Davis.

The One Health Workforce-Next Generation (OHW-NG) project is working in collaboration with the EISMV; the Institute of Health, and Development (ISED); and the Institute of Environmental Sciences (ISE) on various capacity-building programs, including DELTAS, Thrive-2 (Welcome Trust), IRD, Afrique One-ASPIRE, AFROHUN training, RESSOURCE project through the French Global Environment Fund (FFEM) and the European Union. Specific projects include work on rabies elimination, brucellosis control, foodborne disease control, and syndromic surveillance-response systems.

CESAG in Dakar has been targeted as a pilot site for the training of personnel from French-speaking countries for an AMR-specific Infection prevention and control (IPC) training curricula implemented by WHO's Global Infection Prevention and Control Unit.

EISMV students from several disciplines competed in the first "One Health Champion" event at the school (originally through OHCEA – now AFROHUN). The event was organized by USAID's One Health Workforce project with PREDICT, FAO, and the Health Emergency and Operation Center. A dashboard of One Health staff in Senegal is available online.

The Agricultural Research Institute of Senegal (ISRA) is part of a network of public scientific and technological institutions (EPST). It has the specificity of conducting research in four production areas (plant, animal, forestry, fisheries) and related socio-economic aspects, supporting its agricultural vocation. The institute operates in the country's six eco-zones through regional centers, national laboratories, research and production units, and support points for pre-extension and multi-local experimentation.

The Hope For Health Biomedical Research Center (CRB-EPLS) is a Senegalese biomedical research NGO, convening scientists, doctors, engineers, technicians, and administrators for new tools against schistosomiasis and malaria.

Emergency Operations (COUS). Within the Directorate of Prevention, the Division of Surveillance and Vaccine Response has been created. Forty-four priority diseases and conditions are included as part of Senegal's Integrated Disease Surveillance and Response Strategy (IDSR). Cross-sector communication is centralized by the One Health platform, though there are still barriers from individual sectors from lack of data and in information sharing.

DSV conducts annual epidemiological surveillance of priority diseases within the National Epidemiological Surveillance System (NESS). DSV conducts epidemiological surveillance activities and active epidemiological surveillance for select diseases (among them Contagious bovine pleuropneumonia (CBPP), Peste des petits ruminants (PPR), Rift Valley Fever (RVF), foot and mouth disease (FMD), Lumpy Skin Disease (LSD), African Swine Fever (ASF), Bovine, ovine and caprine pasteurellosis, Anthrax, Newcastle Disease (ND), Gumboro Disease, and Marek Disease). Data are collected in the field as paper or electronic files, and outbreak reports are created on paper or electronically. Results from samples sent to the National Laboratory of Livestock and Veterinary Research (LNERV) and other reports from the field office are shared with the DSV. The DSV centralizes field data in a centralized reporting system: SIGEL, Epi-info, or VGTropics. This information is typically disseminated through emails, memos, epidemiological bulletins, reports, or scorecards.

Specific protocols have not been developed in Senegal for wildlife surveillance and sample collection. National parks thus follow a system of passive surveillance: eco-guards and eco-guides report any unusual mortality they observe during their normal workflow. This information is communicated to the respective park's outbreak officials. National Park staff collaborate with the Department of Livestock on disease diagnosis. Additionally, outbreaks or unusual health events are reported by park staff to the nearest veterinarian, then feeding into the routine surveillance pathway of the livestock sector. In 2013, several aborted gazelle fetuses were discovered, linked to an outbreak of RVF.

Consequently, park officials issued a ban on visits, quarantined all affected female gazelles, collected samples for laboratory screening, and vaccinated others in the gazelle herd). Specific guidelines are not in place for veterinarians for sample collection; they base their decisions on the suspicion of disease.

For disease reporting, the national International Health Regulations (IHR) focal point notifies WHO. However, there is no coordination mechanism between the national IHR focal point and the other sectors. In addition, Senegal also lacks a mechanism for the IHR National Focal Point and the WOAHA Contact Point to share information when needed.

Between 2015-2021, eleven outbreak events in Senegal were reported on ProMED (rabies, HPAI, RVF, and a non-diagnosed illness in fishermen).

Access to Diagnostics and Vaccines

Diagnostics

Senegal has a well-equipped central laboratory, the National Laboratory for Livestock and Veterinary Research (LNERV). The laboratory is under the supervision of the Ministry of Agriculture and Rural Equipment and conducts bacteriology, virology, and parasitology screening. There is no in-country veterinary pathology laboratory. LNERV has capacity to diagnose the six priority zoonoses and serves as the regional FAO reference laboratory for FMD, Rift Valley fever, and avian influenza. The Pasteur Institute in Dakar (IPD) has been a WHO reference laboratory for H5 viruses (avian influenza) since 2006, and since the 2009 pandemic has served as a sub-regional laboratory. A BSL-3 facility is located in IPD's Virology Unit. The laboratory has been run by a veterinarian since 2013 and has a comprehensive unit called the Diagnostic and Analysis Centre. All samples are received and processed there for biological analysis (e.g., rabies, HPAI).

As of 2018, the IPD laboratory did not have a laboratory information management system database for management of biological test results. However, as part

of the laboratory's collaboration with MEPA, results can be sent to the DSV over the VGTropics platform, though in practice this is not conducted on a regular basis.

In addition to the central veterinary laboratory, there are six sub-national veterinary laboratories, but these suffer from limited laboratory capacity and inadequate resourcing. Audits of these laboratories are currently being performed. Key challenges include the gap between current resources and the amount needed to cover basic maintenance of the infrastructure as well as that the volumes of samples processed do not provide sufficient income for regular operation. At present, the DSV has neither the technical capacity nor the financial means for operation of these sub-national laboratories.

Senegal is one of the three founding members of the West African Network of Biomedical Analysis Laboratories (RESAOLAB), which was launched by the Mérieux Foundation in 2009 with support from the Agence Française de Développement and by request from the ministries of Health of Burkina Faso, Mali and Senegal. RESAOLAB's operational partners are the Health Ministries of Benin, Burkina Faso, Guinea, Mali, Niger, Senegal and Togo, the ECOWAS West African Health Organization (WAHO) and the WHO-AFRO. As part of this network, Senegal participates in annual training, laboratory supervision, quality assurance, and external quality assessment initiatives. The LNERV is a regional reference laboratory for RESOLAB for the 15 ECOWAS member countries. In this capacity, the reference laboratory performs all diagnostic tests for transboundary diseases, including screening for several zoonoses: Rift Valley fever, rabies, tuberculosis and Anthrax. There is an FAO reference laboratory for avian influenza and transboundary diseases, which also serves as a reference laboratory for the ECOWAS West African Health Organization.

Vaccination

There is a vaccine manufacturing laboratory in Dakar. The facility must obtain the marketing authorization (MA) issued by the animal health authority of the West African Economic and Monetary Unit (WAEMU/OEMOA) in Ouagadougou, based on quality, safety and efficacy criteria. The laboratory then sells the vaccines to the state or to veterinary wholesalers, ensuring the cold chain is maintained. Protocols for acquiring vaccines vary; for example, veterinarians (who are in charge of rabies control and surveillance) purchase vaccines from wholesalers for private use in domestic animals; however, if there are mass vaccination programs through the government, veterinarians are given the vaccines along with coolers and equipment with a mandate to administer them. The number of animals vaccinated and quantity of vaccines remaining is tracked. For human vaccines, the directorate of Pharmacy issues marketing authorization to wholesalers and these wholesalers distribute the products to established pharmacies.

The Institut Pasteur Dakar (IPD) is a major producer of vaccines (e.g. yellow fever). IPD works in collaboration with the Ministry of Health, which has a drug control laboratory and assists in releasing batches of vaccine into distribution. The Senegalese Institute of Agricultural Research (ISRA) also produces vaccines. Collectively these institutions produce the 20 vaccines authorized by the WAEMU, as well as antibiotics (15% of national need). Senegal has the capacity to produce and deliver vaccines, with a cold chain maintained, to most of the country.

PREVENTION AND CONTROL MEASURES

The following diseases were identified as priorities during the One Health Zoonotic Disease Prioritization (OHZDP) exercise: rabies, zoonotic influenza, zoonotic tuberculosis, hemorrhagic fever (Ebola and Marburg), anthrax, and Rift Valley fever (RVF). The DSV has an annual investment budget of between 800 million and one billion CFA francs (US\$ 1.4 - 1.7 million), which includes a budget line for the purchase of vaccines and

consumables. There are no funds allocated to health crises specifically, but there is guidance providing for the release of emergency funds under the ORSEC plan. The ORSEC plan outlines compensation for farmers in the event of emergency slaughter as a result of a disease emergencies; however, in practice compensation is not typically conducted due to the lack of specific funds.

Senegalese regulations allow para-professionals to perform veterinary functions. The production, distribution, and sale of vaccines are primarily under the control, influence, or close supervision of government bodies. The government often determines the pricing for vaccines, but these are not routinely reviewed to promote uptake. When there are insufficient quantities of free vaccines for farmers, achieving supplementary vaccination for the remaining needed coverage is a challenge. Private veterinarians and para-veterinarians are not incentivized to participate in vaccination campaigns when appropriate health mandates are not issued. While private veterinarians have indicated their willingness to contribute to zoonotic disease control, they have reported financial losses when they are involved in vaccination campaigns.

ETHICS

Senegal has general animal welfare legislation, under which individuals can be prosecuted for causing undue suffering to animals. There is no local animal ethics committee/IACUC, but the International Livestock Research Institute (ILRI, in Kenya) assists its network members in ethical review of animal (and human) related research.

Box. Initiatives and Projects in Senegal (examples)

- The EU and the European Investment Bank support key sectors in Senegal for pandemic resilience and improving drinking water supply, public health services and integrated solid waste management.
- The FAO, the World Bank, U.S. CDC, WHO, Catholic Relief Services, PATH, REDISSE, PREZODE, AFROHUN, the Preasens Foundation, and VSF are among partners working on Several partners are working on community-based surveillance, One Health systems strengthening, and zoonotic disease detection.
- The I-Lab project is a component being implemented under RESAOLAB, through the Mérieux Foundation. Launched in 2015, I-Lab brings together over 100 laboratories across the country through an electronic reporting system to identify potential outbreak threats.

SENEGAL CASE STUDY:

Anthrax

CURRENT STATUS

B*acillus anthracis*, a spore-forming soil bacterium, is the causative agent of the disease anthrax. It is highly persistent, able to survive in extreme environmental conditions, remaining viable in the soil for extensive periods of time. Cattle and horses are particularly sensitive to infection. Human infections are linked to ingestion or inhalation of spores or through contact with the skin. Infection can present as four clinical syndromes: cutaneous anthrax (the majority of reported cases), gastrointestinal anthrax from contaminated food, injectional anthrax, and inhalational anthrax (the pulmonary form). The inhalation exposure route presents the greatest concern for biological weapons. Treatment with antibiotics such as Ciprofloxacin can be successful if administered before toxins are produced. Anthrax is listed by WOAHA as a notifiable disease and is one of the 13 priority diseases monitored by Senegal's National Epidemiological Surveillance System.

In Senegal, anthrax is enzootic in the regions of Kédougou, Kolda, Sédhiou and Ziguinchor (in so-called "cursed" fields). It exists in an endemic state, linked to periodic outbreaks, thus necessitating ongoing action to reduce impacts. Historically, the disease caused severe losses in both humans and cattle. The prevention of the animal disease through yearly vaccination has proven effective.

In recent years (2019-2020), nine foci and 536 susceptible animals (28 sick, 19 dead) have been documented following a project to enhance anthrax detection and control in the country (see below). Mammals, scavengers and predatory birds (jackals, hyenas, vultures) are mechanical agents in the dissemination of the spores. Fatal cases of anthrax have been reported in wildlife such as elephants, ostriches, antelopes of various species, monkeys, and wild carnivores (e.g., felids, mustelids, procyonids). The two fully sequenced anthrax strains from Senegal (Sen2Col2 [PRJEB1516] and Sen3 [PRJEB1517]) were isolated in 2010, from an ostrich and Touabire sheep, respectively.

HIGH-LEVEL STRATEGIES

In 2001, with the threat of bioterrorism recognized, a dozen laboratories, including the bacteriology and virology laboratory of the Aristide Le Dantec Hospital, the Pasteur Institute of Dakar and other health structures of the Ministry of Health and the livestock sector, were mobilized to support possible security responses to the anthrax threats. During the ECOWAS OHZDP Workshop in Dakar, Senegal (December 2018) it was recommended to conduct assessments and develop plans to control each of the priority zoonotic diseases. The Framework for Enhancing Anthrax Prevention and Control can help identify opportunities for improvement around control measures such as surveillance, diagnostic capacity, and existing or needed policy recommendations. The government began the establishment of a health security system to prepare for all eventualities. For example, a Senegalese Army physician expressed awareness and readiness with essential effective preparedness measures (experience in previous treatment of cases, and availability of necessary antibiotics).

For veterinary medicine, regional laboratories (including a national reference at the ISRA Hann) support the monitoring of zoonotic diseases, including anthrax in animals. The disease is also subject to targeted vaccination. Epidemiologically, existing data insufficient to determine the prevalence of the disease. Therefore, the implementation of a project on anthrax was developed to enhance work on epidemiological and socio-economic aspects of the disease in Senegal. In 2021, a workshop of the multisectoral Thematic Group of the Global Health Security One Health project on “Zoonoses” was held in Dakar, presenting a project on the control of anthrax in the country. Building on recent work in Côte d’Ivoire, Guinea-Bissau, Togo, Benin and Burkina Faso, and reflecting the impact of the disease on public health and the economy and its transboundary aspect, the West African Economic and Monetary Union (WAEMU/OEMOA) Commission has provided financial support of 750,000,000 FCFA (\$1.16) toward a five-year campaign to combat anthrax in Senegal. Activities commenced under the project in 2019.

SURVEILLANCE

The National System of Epidemiological Surveillance of Animal Diseases (SNSE) created by Order No. 005917 (October 25, 2005) seeks to protect animal and public health and adapt the control of animal diseases in the context of international trade. As a priority disease, anthrax surveillance in Senegal follows the national reporting guidelines. A key objective of the current project for the control of anthrax in Senegal is to improve the prevention, control and response capacities of the Veterinary Services and the capacity for diagnosing the disease in the laboratory. During REDISSE 3 project (2016-2023), supported with funding through the World Bank, a study on the prevalence of anthrax and the characterization of strains in cattle and small ruminants in Senegal was conducted through MAER/ISRA and MEPA. Anthrax surveillance in Senegal is ongoing. Since 2019 the

country had acquired cold chain equipment, sampling kits, and personal protection equipment to support surveillance and vaccination efforts.

PREVENTION AND CONTROL

The National Epidemiological Surveillance System of animal diseases (NESSAD) is operated by the Directorate of Livestock Production with a steering committee, a technical coordination committee and epidemiological surveillance networks for animal diseases. Its functions allowed for early warning and rapid response against anthrax. Because of similar manifestations, differential diagnosis between anthrax and blackleg in cattle is needed. Information through this system prompted vaccination of 50,000 cattle against Blackleg through the Ministry of Livestock.

Senegal has a large and diversified system of laboratories. This includes district laboratories (which performing a certain number of analyses), regional hospital laboratories, and national reference laboratories at the central level, as well as private medical analysis laboratories. There is also a WHO Collaborating Centre on Arboviruses and Haemorrhagic Fever Viruses at the Pasteur Institute of Dakar (IPD).

The national laboratory system performs diagnostic tests for several priority diseases and diseases of public health importance. The LNERV, the Inter-State School of Veterinary Sciences and Medicine (EISMV) and the Pasteur Institute of Dakar (IPD) diagnose animal diseases. Since 2019, through the project to control anthrax, 63,250 small ruminants and 245,336 cattle have been vaccinated. Education and outreach poster and activities have also been developed and distributed to farms in the endemic region. Additionally, 70 livestock agents have been trained in the clinical recognition of the disease and its notification. The country has acquired the “CARBOVIN” anthrax vaccines, cold chain equipment, sampling kits and personal protection along with vehicles to deploy the teams and perform the vaccination campaigns. A One

SENEGAL CASE STUDY:

Anthrax

Health comic booklet has been produced by the Ministry of Education to educate people about anthrax and its animal and human health risks, using drawings to show a dialogue between a field veterinarian and the public.

IMPLEMENTATION GAPS

There is increased activity through the anthrax control project. However, several implementation gaps remain:

- Donor budget is not adequate for surveillance activities: no activities are planned to assess seroprevalence
- Capacity building of implementers is still a priority, but the current budget may not support it
- Lack of consideration for wildlife and the environmental aspects of the disease (ecological and epidemiological factors)
- Non-involvement of private veterinarians in certain surveillance activities
- Reliance on external funding

KEY RECOMMENDATIONS

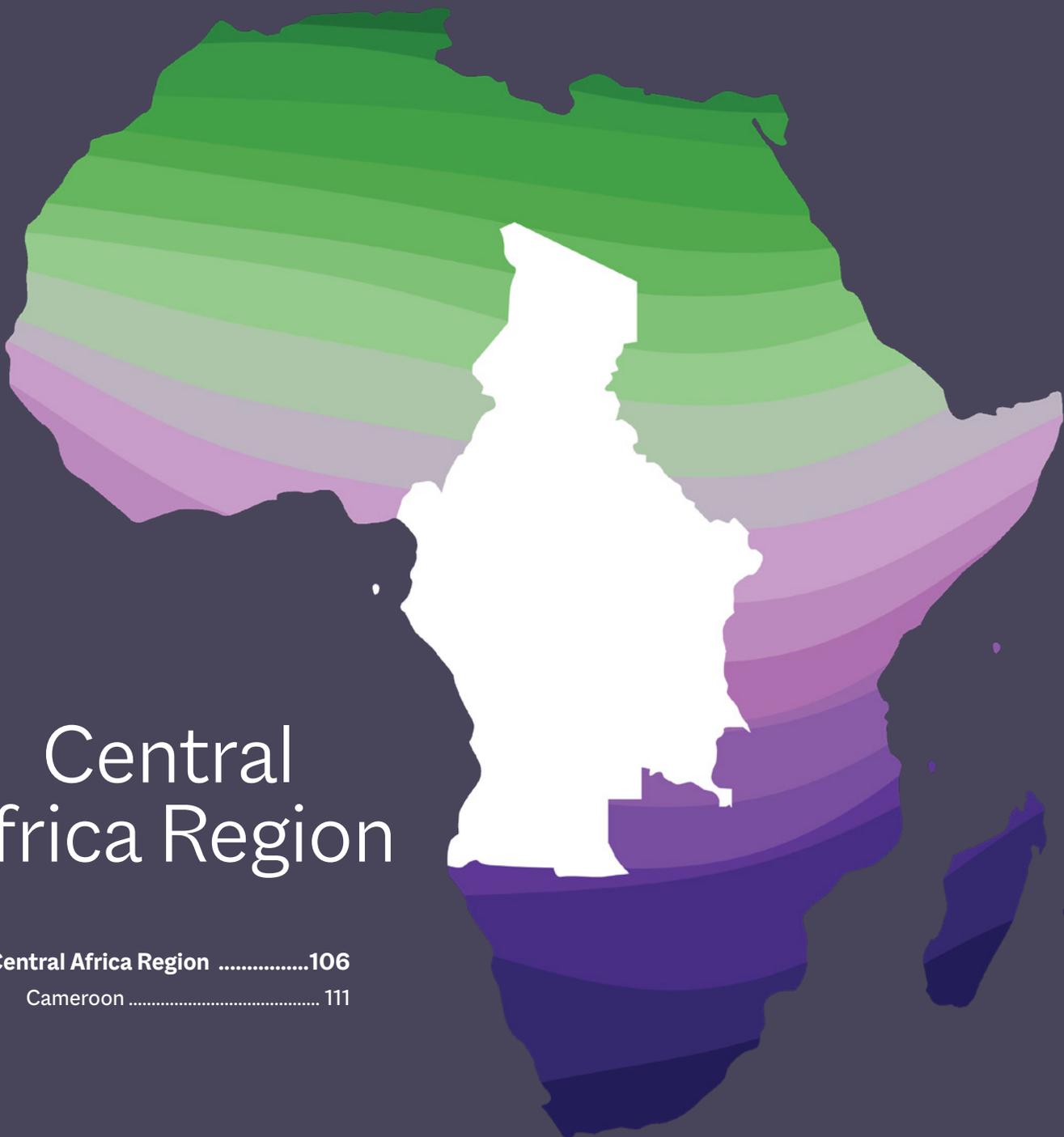
- Enhance and synergize surveillance activities and technical working groups across the region
- Involve and incentivize the private sector in anthrax prevention and control strategies to promote their full commitment, including through compensation (i.e., for losses, for vaccination campaigns)
- Encourage One Health workforce and resource mapping in order to make the case for investment and optimize funds, personnel, and other resources (e.g. cold chain)
- Improve the involvement of sectoral actors (ministries, civil society, private sector, etc.)
- Increase data availability and sharing with other zoonosis groups under the One Health platform
- Extend surveillance to the whole territory

WEST AFRICA ENDNOTES

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Central Africa Region

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Central Africa Region

CONTEXT

The Central Africa region is defined by the United Nations as Angola, Cameroon, Central African Republic, Chad, Congo, Democratic Republic of the Congo, Equatorial Guinea, Gabon, and São Tomé and Príncipe.

As host to important lowland forest and rainforests, serious harvesting of wild meat has been recorded, both for subsistence and commercial use. The region is known as hosting EIDs of concern, including Monkeypox, Ebola and Marburg virus, in addition to endemic diseases.

Major industries include farming (linked to slash-and-burn practices, often of primary forest), livestock herding, and inland fishing (e.g. great lakes). Oil contributes substantially to GDP in several countries, including Gabon, Republic of Congo, and Angola.

The Sangha Trinational in the north-western Congo Basin – a transboundary conservation complex and UNESCO World Heritage site where Cameroon, Central African Republic and Congo meet – includes three contiguous national parks (750,000 ha in total). The area, which has humid tropical forest ecosystems, is largely unaffected by human activity, though logging and other activities make it vulnerable; in IUCN 2020 assessed its conservation outlook as of Significant Concern. Sangha has rich biodiversity, including populations of forest elephants, critically endangered western lowland gorilla, and endangered chimpanzee.

The region includes several least-developed countries, and poverty rates are particularly high in rural populations in northern and eastern Central Africa; food shortages, civil unrest, enduring conflicts all present major concerns. FOMAC provides combat-ready regional standby forces, ready to deploy rapidly

as needed under the peace and security framework of the African Union.¹

CURRENT SITUATION

Regional coordination and governance initiatives

The Economic and Monetary Community of Central Africa (CEMAC) was created in 1994, comprising Cameroon, the Central African Republic, Chad, the Democratic Republic of the Congo, the Republic of the Congo, Equatorial Guinea, and Gabon; it has its headquarters in Bangui.² The Organization for the Coordination in the Fight against Endemic Diseases in Central Africa (OCEAC³) is the implementing agency of the CEMAC in terms of public health. This entity, with headquarters in Yaoundé covering six countries in Central Africa, supports CEMAC on health aspects. Its main missions are the coordination of health policies and actions, capacity building, research and health emergencies (in particular in relation to HIV/AIDS and tuberculosis, malaria, NTDs, vaccine preventable diseases, non-communicable diseases, viral hemorrhagic fevers) and the harmonization of pharmaceutical policies. The WHO Regional Office (WHO AFRO) is based in Brazzaville, the Republic of Congo.

Regional diseases of concern and relevant risk management measures

Key drivers of disease in the region relate to migration, transhumance, animal trade, and livestock production. Transborder movement of livestock and people are prominent in Central Africa and are driven by a number of social and economic factors; among them migration, livestock breeding practices, trade, tourism, education, job searching, and healthcare seeking. The majority of Central Africa's borders with East Africa are porous,

SWOT ANALYSIS | CENTRAL AFRICA REGION

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STRENGTHS

Existing policies and programs from EAC and IGAD related to animal health

Highly competent veterinary and human health workforce

High number of One Health champions associated with AFROHUN

Regional networks for knowledge sharing

Regional laboratory networks (e.g. ASML)

Existing MoUs between countries in region but not all

AMR Surveillance network

W

WEAKNESSES

Porous border crossings, with limited preparedness and protection capacities (e.g. plague)

Centralization of BSL-3 and BSL-4 labs make remote laboratory access challenging

Limited financial resources for sustainable investments

Reliability on external donor funding for pandemic preparedness and prevention activities

O

OPPORTUNITIES

Existing and new MoUs between countries for coordinated surveillance

Joint responses to COVID-19, especially at border posts

Strong investment by pan-African and international donors in laboratory and surveillance capacity

New generation of One Health champions via AFROHUN

New OH curricula through international and pan African academic partnership

T

THREATS

Major discrepancies in health systems and performances between countries in region

Unrest and political instability preventing actions in outbreak areas and leaving regions neglected and without intervention to combat epidemics/epizootics or delay in responding

Migration of human resources reducing competency and capacity capacitated

Extensive investment risking fragmentation and duplication of policies and programs

Complexity of actors in One Health landscape may duplicate efforts

with the potential for introduction and spread of transboundary diseases.⁴ Priority zoonotic diseases in the region are rabies, anthrax, brucellosis, zoonotic influenza viruses and hemorrhagic fever (Ebola/Marburg), trypanosomiasis and yellow fever. The West and Central Africa Veterinary Laboratory Network for avian influenza and other transboundary diseases (RESOLAB) and the regional network of national epidemiological surveillance systems (RESEPI) for Central Africa are involved in zoonotic disease diagnostics.

In 2003 WOAHA signed an agreement with the Economic Commission on Cattle, Meat and Fish Resources in CEMAC to establish technical cooperation between the two parties. WOAHA assisted in harmonizing the animal health legislation and regulations, designing and setting up of an animal health information system, designing and setting up of an epidemiological surveillance system, in the development of standards for intra- and extra-community trade in animals, animal products and fish products and the strengthening of the Veterinary Services through support for the organization of courses and for training in academic institutions in the veterinary and food-processing fields.⁵

Due to recurrent conflict in several large areas of the region including the emergence of extremist groups (e.g. in Cameroon, Chad, CAR, DRC), there is a need to involve and advocate to Ministries of Defense about the importance of a strategic plan for combatting zoonotic diseases in areas where access by medical and veterinary staff is unstable as a matter of national and regional security. In some countries medical professionals have already been involved in Ebola outbreak interventions and securization of the medical staff and treatment centers. Capacity building of troops is however encouraged; there is currently a gap in ensuring that personal protective equipment (PPE) and standard operating procedures are well understood by the deployed contingents.

There is a need to involve and advocate to Ministries of Defense about the importance of a strategic plan for combatting zoonotic diseases in areas where access by medical and veterinary staff is unstable

Regional prevention and control measures

In partnership with the African Society for Laboratory Medicine, national laboratory capacity mapping is supporting establishment of the Regional Integrated Surveillance and Laboratory Network (RISLNET⁶) agenda as well as the implementation of the Antimicrobial Resistance Monitoring and Surveillance Network (AMRSNET⁷). Hosted by Africa CDC, RISLNET Central Africa aims to support Member State capacity to rapidly detect, investigate, effectively respond to, and control disease outbreaks, as well as the advancement and harmonization of surveillance and laboratory policies.⁸ RISLNET applies a One Health approach, encouraging collaboration with national public health institutions, academic institutions, private and public laboratories, centers of excellence, non-governmental and civil society organizations, and veterinary services.⁹

The IAEA, with FAO and through funding from the Peaceful Uses Initiative and the African Regional Cooperative Agreement for Research, Development and Training related to Nuclear Science and Technology (AFRA), is supporting capacity of Central African

countries to use nuclear-derived techniques for zoonotic disease detection. Currently, this initiative is supporting National Veterinary Laboratories (e.g. LANAVET in Cameroon, IP in Bangui, Central African Republic) to pursue specialized diagnostic equipment, with training for their scientists to apply these techniques and the corresponding biosafety measures.¹⁰

Regional training pipelines and research collaborations

In 2010, USAID’s Emerging Pandemic Threats Program supported the creation of One Health Central and Eastern Africa, which has evolved into the Africa One Health University Network (AFROHUN). DRC was among the initial seven countries with participation from public health and veterinary medicine programs. Current academic institutions in the region include the University of the Mountains, The University of Ngaoundéré and University of Buea (Cameroon) and University of Lubumbashi and University of Kinshasa (DRC).¹¹

A new Master’s training programme (“MSc EpiBiostat”) involves “EPI-Biostat Fellows” across Africa, with support through the Africa CDC and European & Developing Countries Clinical Trials Partnership. This new initiative will establish an African cohort of epidemiologists and biostatisticians. Running for three years, all Fellows began the program in 2022; fifteen students at the Kinshasa School of Public Health are enrolled, which will give a strong boost to the country’s and region’s epidemiology and biostatistics workforce and capacity.¹²

REGIONAL PRIORITIES AND COMMITMENTS

Indications of interest and commitment to take on One Health and veterinary programs and systems strengthening

A 2020 review of One Health initiatives in sub-Saharan Africa found that the majority of initiatives (over 100) were located in East Africa, with 65 in Central Africa (and West Africa with 64, which was the fewest).¹³ This signals the need to identify and fill existing regional gaps in Central Africa.

OH curricula are slowly being integrated into national programs in major universities and public health schools of the region, often with EU, GIZ, Pasteur Institute network, IRD and USAID support and partners. This will be important for long-term workforce development, if paired with systematic workforce efforts at national levels, particularly in the public sector.

Many prevention and control measures are ad-hoc projects supported and/or implemented by external partners. These projects are often focused on developing laboratory or surveillance capacity and capacity building. Several current or recent projects are attempting to coordinate human and animal diagnostic and wider surveillance capacity in the region (REDISSE IV, PANDORA, PREZODE, PREDICT, EBO-SURSY). IGAD/ICPALD, AU-IBAR, AU-PANVAC, ILRI, WOAHA, and FAO are also involved. In 2017, the Fight against Neglected Tropical Diseases in the CEMAC region project was launched to support neglected tropical disease (NTD) control and capacity building in five Central African countries. The project is sponsoring interventions targeting NTDs, as well as ~20 PhD students in the region with research focused on NTDs. Funding for this 4-year project was provided by Germany KfW the German government NTDs.¹⁴

Opportunities to leverage regional COVID-19 activities

In addition to demonstrating the need for a regional vaccination strategy, the COVID-19 pandemic has exposed the existing health gaps and challenges in the region. In particular, it has highlighted the relevance of setting up a regional health coordination structure in Central Africa: the Organization for Health in Central African Sub-region (OSAC), which member states had committed to establish a decade ago.¹⁵ In addition, plans are also advancing on an ECCAS sub-regional body to support coordination on health issues. A commission has been formed with the WHO, Africa CDC, and ECCAS to support this process. Further, to reinforce involvement of involving existing health institutions in ECCAS in the process of the OSAC establishment, ECCAS and the WHO are coordinating with the Organization of Coordination and Cooperation for the fight against Major Endemic Diseases in Central Africa (OCEAC).¹⁶ These regional coordination mechanisms could offer important mechanisms for cross-border exchange on disease threats and One Health approaches.

COVID-19...has highlighted the relevance of setting up a regional health coordination structure in Central Africa.

Cameroon



Completed Assessments and Plans

JEE	PVS Evaluation	PVS Evaluation Follow-Up	PVS Gap Analysis	PVS Legislation	IHR-PVS Bridging Workshop	NAPHS	OHZDP	National AMR Action Plan	NBSAP
2017	2006	2011	2011	2011	2021	2018	2016	2018	2015

Indicator	Country	Region Average	Continent Average
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Coordination and Financing

Multi-sector and One Health collaboration/coordination for AMR (1-5)	-	2.00	2.44
Collaborative effort on activities to address zoonoses (0-100)	80.00	42.22	54.23
Current health expenditure per capita (USD)	54.00	93.32	132.25
CFE disbursements (USD)	731,382.00	14,066,100.14	4,903,032.44

Workforce

Veterinarians (total)	4,474.00	1,238.00	3,512.00
Veterinarians (per 1,000 people)	0.19	0.09	0.17
Public animal health professionals (total)	60.00	130.00	461.00
Public animal health professionals (per 1,000 people)	0.00	0.01	0.02
Medical doctors (total)	3,259.00	5,013.00	8,574.00
Medical doctors (per 1,000 people)	0.13	0.28	0.41
Up-to-date multisectoral workforce strategy (1-5)	3.00	2.12	2.19
Progress with strengthening veterinary services (1-5)	—	2.00	2.80

Demographic Factors

Population (total)	25,876,387.00	19,367,603.00	24,185,802.76
Population growth (% , 2010-2019)	27.20	29.12	23.73
GNI per capita (USD)	1,540.00	2,607.78	2,525.37

Environmental and Sanitation Factors

Land area (sq km)	472,710.00	721,868.89	548,414.71
Arable land (% land area)	13.12	4.51	14.14
Forest area (% land area)	43.15	54.50	27.57
Terrestrial protected areas (% land area)	10.91	20.20	16.27
Average primary forest loss (ha)	49,941.45	68,938.35	20,326.14
Access to basic drinking water — rural (%)	39.00	40.91	55.48
Access to basic drinking water — national (%)	60.40	63.26	69.76
Access to basic hygiene — national (%)	9.40	22.62	26.71
Access to basic sanitation — national (%)	39.10	36.84	40.71

Animal Factors

Average livestock stocks (LSUs)	4,597,548.54	4,183,733.13	5,551,123.37
Average livestock exports (LSUs)	1,413.06	8,818.17	33,314.93
Average livestock imports (LSUs)	32,521.14	9,067.12	31,044.50
Mammal species (number)	418.00	291.00	241.65

STATUS OF ONE HEALTH AND VETERINARY SYSTEMS

The Ministry of Livestock, Fisheries and Animal Industries (MINEPIA) is responsible for the development and implementation of Government's policy in the field of animal health protection and veterinary public health. In its implementation and accomplishment of its missions, it is endowed with four technical departments, including the Directorate of Veterinary Services (DVS). It is responsible for research on the renewal of animal, fishery and fish resources, in liaison with the Ministry of Scientific Research and Innovation; the improvement of production and yields in the livestock and fisheries sectors; the improvement of sanitary control in fishing; food security and sanitary controls, the protection of maritime and river resources; and the monitoring of schools and training centers for veterinary medicine personnel and the professions (e.g. Zootechnical and Veterinary Stations into the Station for Intensification and Modernization of Livestock).

MINEPIA supervises the Development and Exploitation of Animal Products Society, the Mission for Development of the Maritime Artisanal Fishing, and the National Veterinary Laboratory (LANAVET). DVS works with LANAVET and the National Laboratory for Quality Control of Drugs and Expertise on compliance with medicines and products for veterinary use, the Special Mission for the Eradication of Tsetse Flies, Centre Pasteur du Cameroun (CPC) on rabies, and Global Viral Cameroon on surveillance of wildlife diseases.

The Ministry of Public Health (MINSANTE) is responsible for the organization, management, and development of public health facilities; health coverage; prevention and fight against epidemics and pandemics; ensuring international medical and health cooperation in liaison with the Ministry of External Relations; medical developments in liaison with the Ministry of Scientific Research and Innovation; and training of doctors, pharmacists and paramedical personnel. It

supervises CPC, the National Laboratory for Quality Control of Drugs and Expertise, the National Supply Centre for Essential Drugs and Medical Consumables, and the Public Health Emergency Operations Centre.

The Ministry of the Environment, Nature Protection and Sustainable Development (MINEPDED) is responsible the sustainable management of natural resources, environmental management measures, monitoring environmental compliance in the implementation of major projects, the protection and restoration of the environment and nature, and negotiating international conventions and agreements relating to the protection of the environment and nature and their implementation, in conjunction with the Ministry of External Relations.

The Ministry of Forestry and Wildlife (MINFOF) and the Directorate of Wildlife is responsible for the inventory, development, management and protection of wildlife species, the issuance of approvals and permits for the exploitation of wildlife resources, the continuous monitoring of the wildlife heritage, the creation and management of hunting zones of game ranches and village hunting zones, the study of the habits and dynamics of animal populations of hunting, scientific and tourist interest, and liaising with international and national organizations in charge of wildlife conservation.

One Health Coordination

Cameroon was one of the first countries in Sub-Saharan Africa to adopt a One Health National Strategy in 2012 and launched several multisectoral responses to zoonotic outbreaks in the years prior. Following the death of several monkeys at the peripheries of Dja reserve from Anthrax in 2005, an international conference was held to put in place a multisectoral program for the control of zoonoses. In 2006, an inter-ministerial committee was held by the Prime Minister to fight the Avian Flu outbreak of February 2006. In 2008, an inter-ministerial committee in charge of developing a multisectoral program for the prevention and control of zoonoses was created and was headed by the Prime Minister.

SWOT ANALYSIS | CAMEROON

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STRENGTHS

Presence of One Health coordination platform backed by government

History of multisectoral collaboration in response to zoonoses with buy-in from high levels of government

Diverse engagement of sectors involved in One Health activities at a national level

Robust training institutions

Laboratory and diagnostic institutions

In-country production of animal vaccine

One Health research networks

W

WEAKNESSES

One Health activities have not been operationalized at a sub-national level

Challenges with financing

Staff turnover and loss of One Health champions threatens institutional knowledge

One Health activities focused mostly on zoonoses

Multisectoral collaboration exists, but is focused on preparedness (for response and planning)

Few controls on quality and safety of agricultural products and wildlife products for consumption

O

OPPORTUNITIES

Number and size of protected areas (and commitment to expand protected areas)- creation of 10 new national parks

Unique coordination role across regions (West and Central Africa)

Strengthen One Health collaboration with defense and security forces, building on involvement in management of recent disease events and several topics of relevance

T

THREATS

Complex emergencies in the Southwest and Northwest regions, which disrupts VS service delivery; agriculture production and trade

Migration of refugees from Central African Republic and Nigeria

Robust international wildlife trade

Consumption of bushmeat (e.g. rodents and non-human primates), particularly in rural areas

Demand of animal meat for consumption exceeds national production capacities

Transhumance, and potential for conflict between farmers and livestock herders in the Adamawa and North regions.

Natural disasters (e.g. heavy rains and floods, fires)

Sanitation situation is deteriorating, with declines in the proportion of population having access to improved sanitation facilities

In 2012, the National One Health strategy was validated and signed by four ministries instructed by the Prime Minister. It is based on five domains: i) setting an institutional framework, ii) training and knowledge sharing, iii) developing research on emerging and re-emerging diseases, iv) strengthening surveillance systems for humans, animals and the environment sectors, and v) communication and One Health advocacy. The National Program for the Prevention and Fight against Emerging and Re-emerging Zoonoses was signed in 2015. This instrument was articulated around three strategic axes constituting its three components namely: i) Reinforcement of Epidemiological Surveillance, Investigation and Prevention of Emerging and Re-emerging Zoonoses; ii) Reinforcement of Basic and Operational research on Zoonoses; ii) Reinforcement of Training in the Prevention and Fight against Emerging and Re-emerging Zoonoses. This provided a mechanism for a single ministry authorization for multi-sectoral disease investigations; soon after, this process was deployed in an investigation of monkeypox in chimpanzees, allowing for efficient One Health coordination and effective event resolution.

Though formally part of ECCAS, Cameroon maintains collaboration in several regional entities, which can be an asset for knowledge exchange. Delegations from Cameroon have participated in ECOWAS One Health Technical meetings held in 2016 (in Dakar) and 2019 (in Lomé).

Following the PVS evaluation (2006), DVS developed the animal health and veterinary public health policy document that takes into account aspects of the One Health approach. The general objective of the policy is to improve the skills of the Veterinary Services to guarantee animal health and veterinary public health in order to reduce the impact of animal diseases on the productivity of livestock, to protect consumers and to remove the difficulties of accessing the external market

for foodstuffs of animal and fishery origin. One Health activities are anchored aims to strengthen the protection of human populations from public health risks related to emerging and re-emerging zoonoses. It aims to do this by strengthening the capacity for rapid detection and response to emerging and re-emerging zoonoses (e.g. detecting and reporting epidemiological events related to zoonoses within 48 hours of the beginning of health crises) and improving the coordinated control of priority zoonoses.

The operationalization and functioning of the National One Health platform has encountered many challenges and the approach has yet to be operationalized at all regional levels. The One Health approach has yet to be integrated in sectoral strategies—a necessity for multisectoral collaboration.

Since disasters are managed by the Directorate of Civil Protection in the Ministry of Territorial Administration and sometimes the Presidency excludes the National One Health platform from coordinating a multisectoral response. The strategy is more centered on zoonotic diseases and less on other One Health events like antimicrobial resistance, food safety/food security and biosecurity.

The current legal framework for financing emergency operations is also unclear and complex. This was evident with COVID-19, where either the head of state gives funds or aid is given or MINAT financing. The establishment of the Basket Fund at the Central Bank with several Programs and Projects having a single financing mechanism has often led to the unavailability of funds. The procedures for making funds available to implement One Health activities have also been reported as becoming increasingly cumbersome.

The communication and training on the One Health Approach is insufficient in public institutions. This is in part due to staff turnover. Focal points that are trained on One Health may be called in elsewhere, requiring new focal points to be trained.

Box.
**Organization of Cameroon's
One Health coordination
platform**

The institutional basis of the program depends on three principal organs namely: i) the Steering committee; ii) the Technical Orientation Committee; and iii) the National Coordination Secretariat.

Steering Committee

The Steering Committee is in charge of the National Strategy on One Health. It is presided by the Prime Minister and composed of the Minister of Livestock, Fisheries and Animal Industries; the Minister of Public Health; the Minister of Forestry and Wildlife; the Minister of Environment, Nature Protection and Sustainable Development; the Minister of Territorial Administration and Decentralization; the Minister of Scientific Research and Innovation; Minister of Finance; the Minister of Higher Education; the Minister of Economy and Planification; the Minister of Communication; the Minister of Tourism and Technical and Financial Partners.

Technical Orientation Committee

Members of the Technical Committee, who must be distinguished scientists, have the responsibilities of providing sound technical knowledge and opinions for the successful and smooth running of the Program. The Technical Orientation Committee is made up of by:

- The Technical Directors of all the concerned Ministerial Departments
- One representative from each of the following National Orders: Medical Doctors, Veterinary Doctors, and Pharmacists
- One representative from the civil society; and
- One representative of hunters' guide.

The Technical Orientation Committee is assisted by a Scientific Committee that is co- presided by the Ministry of Scientific Research and Innovation and the Ministry of Higher Education; other members of the committee are drawn from the Ministries of Livestock, Fisheries and Animal Industries; Public Health; Forestry and Wildlife; and Environment, Nature Protection and Sustainable Development.

Permanent Secretariat

The Permanent Secretariat is responsible for programming, executing and coordinating all activities of the Program. This includes monitoring and evaluation and administration. It is led by the Ministry of Livestock, Fisheries, and Animal Industries.

Training Pipelines

A National Plan for the Development of Health and Human Resources (2013-2017) exists, but implementation remains limited and Cameroon faces a human resource crisis. In terms of low density of health workers, some of the major challenges faced by Cameroon in the past decade include an inequitable geographic distribution of health workers, particularly in rural areas and Northern regions, and an aging public sector health workforce. It is estimated that 15% of current public sector health workers were lost to retirement between 2010-2012.

The University of Buea offers a bachelor's program in Animal Science; Master's program in Livestock production, Fisheries and Aquatic Sciences, and is launching a program in Wildlife Health; PhD programs in Animal Production, Fisheries, and Fisheries and Aquatic Sciences; and DVM. The University of the Ngaoundéré

through the School of Veterinary Medicine and Sciences offers DVM, Master's and PhD program in Veterinary Public Health, Master's program in One Health, Master's and PhD program in Genetics. In 2021, AFROHUN developed AMR curriculum which will be implemented in major public health schools in Cameroon. This curriculum involves public health and veterinary faculty of Health Sciences at the University of Montagnes, faculty in Health Sciences, Agriculture, and Veterinary Medicine at the University of Buea, faculty from the School of Veterinary Medicine and Sciences of the University of Ngaoundéré and technical partners such as FAO and USAID.

Since 2010, the Cameroon Field Epidemiology Training Program (CAFETP) has been implemented by the Ministry of Public Health and the Ministry of Higher Education through the University of Buea. From 2010 to 2015, the program was known as the Central African Field Epidemiology and Lab Management Training Program (CA-FELTP) and was part of the Strengthening Surveillance and Response in Central Africa program, which was funded by the Bill and Melinda Gates Foundation and focused on strengthening surveillance in Central Africa. Over a period of five years, CA-FELTP

Box. **Snapshot of Training Initiatives with International Collaboration**

- FAO, in collaboration with the Institute of Infectious Animal Diseases (IIAD) at the University of Texas A&M, launched the training program for veterinary professionals in field epidemiology (ISAVET) Basic Level. This support is part of the fight against endemic diseases, emerging infectious diseases and transboundary animal diseases. Trainees are from government services, notably the Ministries of Livestock (MINEPIA) and Wildlife (MINFOF), and are working on the respect of biosecurity measures at the farm level and on techniques for collecting, packaging and transporting samples to the laboratory.
- In 2020, FAO through its Emergency Centre for Transboundary Animal Disease Control (ECTAD), and in collaboration with the Ministry of Livestock, Fisheries and Animal Industries (MINEPIA) of Cameroon trained agents of the basic veterinary services to strengthen their technical capacities on the management of epizootics.
- AFROHUN (formerly OHCEA) in Cameroon and the National Observatory for Public Health cohosted a workshop on bio-safety and bio-security where it was suggested that academic programs integrate knowledge of biosafety and biosecurity.

trained 52 medical doctors, veterinarians, and laboratory technicians from Cameroon, the Democratic Republic of Congo, and the Central African Republic.

In 2017, the Africa One Health University Network, USAID, and One Health Workforce project produced a technical document entitled “Human Resources Needs According to OH Approach in Cameroon”, which involves public health and veterinary faculty of Health Sciences at the University of Montagnes composed of and faculty of Health Sciences, Agriculture, and Veterinary Medicine at the University of Buea.

DISEASE MANAGEMENT

Surveillance and Reporting

The Cameroon Epidemiological Network for Animal Diseases (CENAD) is the government’s tool for animal disease surveillance. It sits within the Ministry of Livestock, Fisheries and Animal Industries. CENAD is composed of ten regional units, sixty epidemiological surveillance posts at the departmental level, one specialized wildlife unit, twenty observation posts in the main protected areas (North-West, Far North, Adamawa), in addition to inspection posts in airports

(Douala, Yaounde, Garoua), border posts, veterinary health inspection posts, and Zootechnical Veterinary Centers.

Animal epidemiological surveillance operates at four levels: 1) Field level with communities, farmers and other actors of the livestock sector; 2) Local level with the field agents of the Zootechnical Veterinary Centers, clinicians, and health inspection posts; 3) Intermediate level with the decentralized services of Ministry of Livestock, Fisheries and Animal Industries; and 4) Central level with the Directorate of Veterinary Services and the permanent secretariat of CENAD. In addition, surveillance is multi-sectoral, and there is collaboration between the different stakeholders according to the One Health approach.

CENAD conducts both active and passive surveillance. Active surveillance is implemented for certain diseases (e.g. Ebola and HPAI) by the central level, LANAVET/ INEPIA and Research Center for the Health of the Armed Forces/Metabiota laboratories, including recently through the implementation of the PREDICT-2 component of Emerging Pandemic Threats-2/GHSA in Cameroon financed by USAID. Passive surveillance is

Table.
List of CENAD priority diseases, Cameroon (2020)

ECONOMIC DISEASES		ZOO NOTIC DISEASES		
Viral	Bacterial	Viral	Bacterial	Parasitic
Contagious Bovine pleuropneumonia	Avian Typhosis	Rabies	Tuberculosis	Trypanosomiasis
Peste des Petits Ruminants	Avian cholera	Highly pathogenic avian influenza	Anthrax	
Food and Mouth Disease	Symptomatic anthrax	Ebola	Brucellosis	
African Swine Fever		Monkeypox	Salmonellosis	
Newcastle		Lassa fever		
Pasteurellosis				

conducted by data collectors at the base, MINEPIA staff, Heads of Animal Health Centers, and Heads of Veterinary Inspection Stations and Checkpoints.

Epidemiological surveillance targets livestock/economic diseases and zoonotic diseases (Table). CENAD's surveillance tools include a weekly epidemiological bulletin, notification forms, a telephone fleet, a toll-free number, and the Cameroon Animal Health Information System.

The National Public Health Surveillance System is an implementation unit of the Integrated Disease Surveillance and Response (IDSR) in Cameroon. Across three levels—central, regional, and district—the National Public Health Surveillance System mostly implements passive surveillance also active surveillance, including sentinel surveillance in health facilities, indicator- and event-based surveillance.

The National Public Health Observatory (NPHO) is the national IHR focal point and sits within MINSANTE. Its general mission is the alert and health watch in collaboration with the Department to Fight Against Illness, Epidemics, and Pandemics, the centralization, the analysis and the implementation of the socio-sanitary information, the databases and the establishment of data banks on the public health problems. It facilitates the exchange of information for decision support and coordinates the Cameroon Health Data Collaborative, which is a network that produces and uses health data. NPHO data comes from two sources - Domestic data from surveys (e.g. INS, BUCREP, local research institutes/organizations); publications produced from surveys and administrative data financed by a third party external to the Ministry of Public Health; publications produced from surveys and administrative data financed by the Ministry of Public Health; and international data - From global and specialized international databases; databases of the United Nations system (e.g. WHO, UNICEF, UNFPA, World Bank).

NPHO conducts national and cross-border epidemiological surveillance. It has weekly data collection forms for public health events at entry and transit points. Through a weekly presentation, the NPHO communicates its information to Cameroonian decision makers on public health emergencies in Africa and the world and the level of risk for Cameroon. At the same time, public health events occurring throughout the national territory are notified to the WHO in a timely manner.

CENAD's Animal Health Information System (CAHIS) is a free and open-source software. This data analysis and management platform is entirely web-based and offers extensive visualization features and the ability to create analysis from live data. This tool, which will improve the system of collection and management of animal health data and its availability in real time, will be installed in all services, up to the decentralized levels. It has the particularity of being interoperable; thus, information can easily be shared with other sectors (such as the Ministry of Health through their DHIS-2 information system) on public health issues.

Access to Diagnostics and Vaccines

Diagnostics

The animal disease surveillance laboratories network consists of the LANAVET, and two BSL-2 laboratories, the Centre Pasteur du Cameroun (CPC), which is involved with diagnosing rabies, and the Research Center for the Health of the Armed Forces.

LANAVET is a public company created in 1983. It is placed under the dual technical supervision of the Ministry of Livestock, Fisheries and Animal Industries and the financial supervision of the Ministry of Finance. It is headquartered in Garoua. In 2013, LANAVET opened an annex in Yaoundé with BSL-2 and BSL-3 capabilities, with the aim of bringing its diagnostic services closer to farmers in the southern part of Cameroon. Other annex laboratories were then opened in 2019 in the Adamawa, Littoral and West regions (Ngaoundere, Douala and Bafoussam), all of which are BSL-2.

LANAVET has a good technical platform for the diagnosis of animal diseases (bacterial, viral and parasitic), the production of vaccines and for quality control. It also performs biochemical analysis on blood or organ samples, feeds and animal products. In February 2021, the Head of State approved the statutes of the National Veterinary Laboratory. LANAVET's Animal Production Department is ISO (International Organization for Standardization) accredited for Peste des Petits Ruminants (PPR) and Contagious Bovine Pleuropneumonia. For avian diseases such as avian influenza and Newcastle disease, LANAVET sends samples to the WOAHA reference laboratory in Padua, Italy.

LANAVET is a member of RESOLAB (Network of Veterinary Diagnostic Laboratories for West and Central Africa). It collaborates with CPC (rabies diagnosis), the Center of Research for Emerging and Re-Emerging Diseases, specific laboratories of the Institute of Agriculture Research for Development, universities, veterinary schools, and protected areas. It also collaborates with international organizations involved in the fight against epizootics, including International Atomic Energy Agency (LANAVET receives trainees from there and obtains training grants in Austria for its staff); FAO (provides most of the reagents to LANAVET), Friedrich Loeffler Institute (WOAHA reference laboratory with which LANAVET has a partnership for the control of arboviruses) and Pan African Veterinary Vaccine Centre of the African Union (reference laboratory of the African Union in Ethiopia for quality control and certification of vaccines produced by LANAVET).

Vaccination

Among the diseases monitored in the framework of the epidemiological surveillance network for animal diseases in Cameroon, those that have vaccines produced locally at LANAVET are shown in the Table.

Table.
List of vaccines produced at LANAVET

Vaccine	Disease
ANTRAVAX	Anthrax
CAPRIPESTOVAX	Small Ruminant Plague
MULTIVAX	Newcastle, avian typhosis, avian cholera
NODULOVAX	Cutaneous nodular dermatosis
PASTOVAX	Pasteurellosis
SYMPTOVAX	Symptomatic anthrax
PERIVAX	Contagious bovine pleuropneumonia

PREVENTION AND CONTROL

There are National Operational Plans for Eradication of two priority animal diseases (PPR and FMD). With the technical support from FAO and WOAHA, Cameroon is implementing control programs for PPR and FMD.

Each year, vaccination campaigns against these diseases are organized by the veterinary services in each region. For human diseases such as polio, the Ministry of Public Health organizes vaccination campaigns in hospitals and, if necessary, sends its staff into the field to vaccinate households. For zoonotic diseases such as rabies, the Cameroon Pasteur Center and Ministry of Health ensure the post-exposure vaccination of people with an internationally produced rabies vaccine.

Cameroon has 54 Protected Areas (land: 10.98% and marine 10.89%) with 30 providing management effectiveness evaluations, including 19 national parks. Additional commitments to increase protected area coverage to 7.4 million hectares have many implications from a One Health perspective, including potentially playing a role in reducing human-wildlife contact. In 2017, Worldwide Foundation Cameroon adopted a Wildlife Trade Policy, which will be used to support the work of the government in wildlife management in protected areas. WWF Cameroon and the NGO LAGA support wildlife law enforcement in and around

protected areas, the operationalization of regional and departmental multi-stakeholder enforcement platforms for wildlife law enforcement, and tackling emerging threats arising from large investment projects (e.g. mining, expansion of palm oil).

Lessons learned during the management of epizootic diseases from 2010 to 2016 provided an understanding of the important role played by the defense and security forces (national police, national gendarmerie and army) in the control of animal health and veterinary public health events. Indeed, the management of African Swine Fever has involved civil-military actions to control the movement of animals or their products throughout the territory, securing outbreaks, sanitary slaughter, and management of burial pits. This has reduced the incidence of the disease from 3% to 0.01%, and the cost of the disease.

These actions were also noted for the management of avian flu, with the addition of the management of contaminated droppings and food and the disinfection of live poultry markets by the fire department. In addition, the “Centre de Recherche pour la Santé des Armées” contributed to the confirmation of the disease through laboratory analysis by PCR. Since the closure of the outbreaks in 2017, surveillance continues with the involvement of the police, the national gendarmerie and the national customs in the health watch activated throughout the territory to consolidate the country’s disease-free status.

The action of the defense and security forces is also visible and important for:

- The management and security of livestock in conflict zones: important role of the gendarmerie and the Rapid Intervention Battalion;
- Vaccination campaigns, where the security of the movements of the veterinary services by the defense forces in the Adamawa, North and Far North regions

Box.
**Snapshot of Projects in
Cameroon**

MINEPIA is supervising the livestock development project (PRODEL) to improve the productivity of the targeted production systems and the marketing of their products for the selected beneficiaries and, to provide an immediate and effective response in case of crisis or eligible emergency. Under this project, with financing up to \$100 million from the World Bank, MINEPIA allows for the reallocation of Project resources in the event of a natural disaster to organize response and reconstruction operations. This component will draw its resources from unallocated expenditure categories and allow MINEPIA to request from the World Bank the re-categorization and reallocation of resources of the Project components in order to cover the costs related to the rapid response. Additional resources may also be mobilized if available during eligible emergencies. The project, which is in progress, has reported intermediate results including reduced ruminant mortality rate.

on the borders with Nigeria is essential for achieving the immunization objectives. The same is true for the Northwest and Southwest regions;

- Theft of livestock and kidnappings of herders are becoming more and more frequent: Here, the important role of the defense forces in the Adamawa and North regions on the borders with CAR is gradually restoring peace of mind among pastoral families;
- Management of the Monkeypox outbreak in the conflict zones (Northwest and Southwest).

ETHICS

There is a National Committee on Ethics in Human Health and a framework for consultation on health research through the Scientific and Strategic Advisory Commission for Research in Human Health. The Ministry of Forestry and Wildlife and the Directorate of Wildlife is responsible for the issuance of approvals and permits for the exploitation of wildlife resources.



- High faunal and flora biodiversity
- Three livestock production systems: pastoral, mixed crop-livestock, and commercial; smallholder production is the predominant form
- Among the threats to biodiversity are poaching, habitat loss and degradation, conversion to agro-pastoral systems, and poisoning
- Domestic demand for livestock protein exceeds national production
- Wild meat value chain plays an important economic, social, and culture role in the region, particularly for rodents and non-human primates
- High dependence on wild meat for animal protein by forest households
- Bat hunting, sale, and use in food in restaurants
- Indirect contact with bats, including in caves and in consumption of contaminated fruit
- Conflict is impacting agricultural production and trade

CAMEROON CASE STUDY:

Foot and Mouth Disease

CURRENT STATUS

Foot and mouth disease (FMD) is considered the most contagious infectious disease of cloven-hoofed domestic and wild animals. The disease is endemic in Cameroon and the country is also susceptible to this transboundary animal disease with the major livestock transit routes between Central and West Africa (sharing a border with 6 countries). FMD is a key limiting factor to animal production and trade. The direct economic consequences from FMD are estimated at 62 billion FCFA (\$94 million) annually; roughly half from expenditures on drugs for treatment and the rest from premature death of affected animals.

To align with the global strategic plan to fight against FMD elaborated by FAO and WOA, the government of Cameroon is committed to sustainably reduce the impact of FMD on the livestock sector. To that effect, a systematic and comprehensive nationwide assessment of the epidemiological parameters of the disease and its associated risk factors resulted in the development of a national strategic plan for the control of FMD published by FAO in 2015. This five-year plan targeted animal vaccination, post vaccination monitoring, reinforcing the performance of veterinary services, improving livestock management practices and controlling livestock movement. To achieve these targets, the Ministry of Livestock has developed an operational plan to control FMD in Cameroon.

FMD is endemic in Cameroon and the spatial distribution determined in 2012 showed that except for the Littoral region, all regions of Cameroon had infected animals. A review of existing literature on FMD in Cameroon identified 12 studies carried out from 2003 to 2019. The disease was found in the Adamaoua, East, North and Far-North regions. A pooled prevalence of 4.4%, 8.1%, and 39.4% were obtained in pigs, sheep and cattle respectively. Five serotypes of the virus have been found (A, O, SAT1, SAT2 and SAT3).

Poor livestock housing, reproductive and feeding practices, and herd health management contribute to transmission and maintenance of FMD in Cameroon. Other risk factors and risk hot spots relate to transhumance, wildlife-domestic animal cohabitation and contact, livestock markets, and poor regional collaboration. Additionally, significant weaknesses at points of entry are effectiveness of the veterinary sanitary inspection (VSI) and the porosity of the borders. There are no veterinary facilities at border crossings; VSI is limited to fee collection. Imported animals are generally given no FMD-specific inspection. Millions of heads of ruminant livestock come annually with transhumance movement from Chad, Niger and Nigeria to the country's Far-north.

HIGH-LEVEL STRATEGIES

The most outstanding measure towards developing an enabling environment for control activities in Cameroon is the Government's commitment to control the disease as shown by its decision to formally develop a strategic control plan and its operationalization. At the level of the Ministry, FMD control is supervised by the Directorate of Veterinary Services with a National Coordinator appointed by the Minister of Livestock, Fisheries and Animal Industries. A National Consultative

Committee for the Control of FMD will be created by Order of the Prime Minister to coordinate the extensive number of agencies and stakeholders which need to be engaged to successfully implement control plans.

The control strategy document aims at reducing the impact of FMD, prescribing a step-by-step approach. Phase 1 of the plan will focus on improving the understanding of the epidemiology of FMD and implementing a risk-based approach to reduce its impact. Phase two, which corresponds to the three years following phase 1, has an objective to implement risk-based control measures such that the impact of FMD is reduced in one or more livestock sectors and/or in one or more zones. Phase 3 of the control strategy, corresponding to the five years following completion of stage 2, seeks the progressive reduction in outbreak incidence followed by elimination of FMDV circulation in domestic animals in at least one zone of the country.

The FMD operational plan focuses on four components: 1) Improving the intervention capacities of actors; 2) Protection of cattle herds; 3) Monitoring and epidemiological monitoring-evaluation; and 4)

Coordination and monitoring of activities. A pilot phase of the strategic plan took place in two stages. The first stage was through the operationalization of the sanitary mandate to private veterinarians, and the second stage targeted vaccination in MINEPIA breeding stations and the ranches. In 2014, four divisions were the subject of the pilot phase of the sanitary mandate, in particular Bui and Mezam in the North-West region and Vina and Mbéré in the Adamaoua region. The implementation of this mandate was marked by the sensitization of breeders, and a vaccine subsidy from the government. The second phase of operationalization was carried out the following years exclusively in SODEPA ranches and breeding stations of MINEPIA. During this phase, a herd of 20,599 animals was nearly all (99.03%) vaccinated.

SURVEILLANCE

FMD is one of the priority diseases of the National Epidemiosurveillance Network. There is a well-structured surveillance network created by ministerial decision and operational at the central administration, but there are no field staff. When eventually constituted and appointed, the field staff will need to

Box. Wildlife-Livestock Interfaces

Cross-Border Trade: The main destination of animals that enter from Chad into the Far-north Region of Cameroon is the State of Borno, Nigeria. In the course of transit they mix with national herds on transhumance towards the Waza National Park, coming into contact with wild ruminants through sharing of pasture and water resources and through direct contact. Movement through the North and Adamaoua regions from the Central African Republic face a similar situation in the Benoue and Bouba-Njidda game reserves on the way to Adamaoua State in Nigeria. Transit to Gabon and Equatorial Guinea also occurs in the South Region.

National Transhumance: Transhumance with livestock is another major virus distribution mechanism, involving southward movement of livestock into game reserves, the Guinean savannah, the northwestern grasslands and the forest ecological zones. These zones generally have high buffalo, antelope and warthog populations which are susceptible to FMD.

CAMEROON CASE STUDY:

Foot and Mouth Disease

be properly trained in FMD-specific monitoring and surveillance. As a temporary measure, the chief of sections serve as operational field staff; however, a problem of chain of command exists as they are subject to authority by the Divisional Delegates and Regional delegates rather than the Regional chief of veterinary services.

Currently, surveillance is essentially passive, based on disease case reporting in all susceptible species by independent actors in the field (breeders, local veterinary agents). Data are collected at the level of the most decentralized veterinary services in all regions and at borders and forwarded to the Directorate of Veterinary Services in monthly reports. Active surveillance can be attributed to research projects carried out by LANAVET or universities.

PREVENTION AND CONTROL

In 2013 a pilot vaccination campaign was launched by the Ministry of Livestock in the Adamaoua and North-west regions. Veterinarians in private practice were mandated to carry out the vaccination exercise. There was no post-vaccination monitoring and as such the campaign was not evaluated. At the farm level, husbandry practices do not allow appropriate control strategies. Herd owners are not well organized and very few belong to farmers' organizations, thus information on good disease management practices is not widely shared or practiced. Since mortality from FMD is low, owners are more concerned with other diseases that cause higher levels of mortality and economic losses. Cost effectiveness of prevention and control methods has not been determined and the baseline economic losses due to FMD and a comparison with other livestock diseases have not been established.

REGIONAL CONSIDERATIONS

As a WOAHA Member State, Cameroon has adhered to the progressive approach to the control of FMD, which aims to gradually reverse the disease and reduce its viral load. The country is a signatory to all regional animal health conventions, and the national Veterinary Laboratory is the focal point for the regional laboratory network in Central Africa. The first regional meeting of the FMD Roadmap for Central Africa took place in Douala in September 2018, organized by FAO and WOAHA. The FMD Progressive Control Pathway has been found to correspond to the needs of the region and will be monitored by countries. The 8 countries present at the meeting agreed to:

- Establish a Regional Consultative Group, elected for a 3-year period (2018 - 2021)
- Use the results of the assessments conducted during the Douala meeting as a basis for establishing the draft table of the roadmap for Central African countries
- Identification of priority activities for improved implementation of the global FMD control strategy at regional and national level

IMPLEMENTATION GAPS

Despite the series of efforts made by all stakeholders in the fight against FMD, many weaknesses are observed in the country and include:

- Gap in the legislative and regulatory framework: FMD is a notifiable disease according to the law N° 006 (16 April 2001); however, this law is not always applied, resulting in low immunization of animals and multiplication of disease foci. Additionally, lack of legislation on compensation disadvantages a proper implementation of surveillance and control activities
- Surveillance system: the epidemio-surveillance network does not have a formal framework for

information sharing specific to FMD, and lack of human, logistical and financial resources hinder surveillance implementation

- Laboratory capability: The national veterinary laboratory does not have ability to produce FMD vaccine, and its ability to test samples remains limited
- Unreliable statistical data: There are still major gaps in knowledge on the true epidemiological situation and circulating strains in Cameroon. Current data are not robust enough for mapping, and no comprehensive study has been carried out to evaluate the socio-economic impact of FMD on different stakeholders. Available data on disease control does not make it possible to accurately assess control efforts (vaccination coverage rate)
- Vaccination strategy: In the pilot vaccination strategy the major gap was insufficient sensitization of the cattle owners, resulting in their reticence towards the campaign

KEY RECOMMENDATIONS

At the regional level, a joint surveillance program should be implemented. At the country level, the government should:

- Invest in surveillance to have a true picture of the disease and circulating strains in the country, and provide baselines to measure the success of vaccination programs
- Reinforce surveillance at borders and control movement of animals out of and within the country
- Ensure sensitization of cattle owners as an essential pre-requisite for vaccination campaigns
- Increase diagnostic capacity of laboratories

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East Africa Region

CONTEXT

The East African region is defined by the United Nations as Burundi, Comoros, Djibouti, Eritrea, Ethiopia, Kenya, Madagascar, Malawi, Mauritius, Mozambique, Rwanda, Seychelles, Somalia, South Sudan, United Republic of Tanzania, Uganda, Zambia, and Zimbabwe. The regional population is on track to double by 2050.¹

The region is highly diverse in terms of its major industries, ranging from tourism to livestock production and livestock exports. There is a high dependence on livestock production and trade, particularly where other land use options are limited given arid or semi-arid conditions.² Rain-fed agriculture and pastoralism are fundamental to livelihoods and nutrition in many parts of the region, and are highly vulnerable to climate change. The movement of livestock and people across borders is common.

The region is known as hosting emerging diseases of concern (e.g. Ebola, Marburg, and Rift Valley fever) as well as endemic diseases (e.g. Plague in Madagascar), and faces a high burden of HIV/AIDS. East Africa experienced a major invasion of desert locusts in 2020 that affected crop production, with the scale of the event attributed to rain conditions in the Arabian peninsula and horn of Africa in preceding years.

Prior to the COVID-19 pandemic, wildlife tourism — anchored in protected areas — contributed an estimated \$6 billion per year to the region's economy.³ Poaching and wildlife trafficking in the region present a serious threat to biodiversity, though the region as a whole has made substantial advances in tackling wildlife crime, including through law enforcement, ranger workforce development, and technological innovation.

CURRENT SITUATION

Regional coordination and governance initiatives

The East Africa geographical divisions vary according to the United Nations, the African Union, the East Africa Community and the Intergovernmental Authority on Development, sometimes overlapping with countries classified by the African Union as Central or Southern Africa. Regional governance of six states (Burundi, Kenya, Rwanda, Tanzania, Uganda, and South Sudan) is overseen by the East African Community (EAC). The Intergovernmental Authority on Development (IGAD) is an eight-country bloc (Djibouti, Ethiopia, Eritrea, Kenya, Somalia, South Sudan, Sudan, Uganda) with a mandate that includes development, and a focus on peace and security in the region. Discussion has been ongoing about a potential merger.

The EAC Treaty identifies priority health activities in the region, including a Disease Prevention and Control Unit which has prioritized the following interventions: 1) a regional information exchange system for communicable diseases; 2) supranational regional reference public health laboratory and strengthening national public health laboratories; and 3) strengthening EAC Partner States to diagnose and treat communicable diseases.

The EAC also has a protocol on Environment and Natural Resources Management,⁴ and a Regional Biodiversity Strategy and Action Plan and a Wildlife Conservation and Management Policy.⁵ Since 2019, EAC has been collaborating with USAID, IUCN, World Wildlife Fund and TRAFFIC on coordinating and implementing their strategy to Combat Poaching, Illegal Trade and Trafficking of Wildlife and Wildlife Products.⁶

SWOT ANALYSIS | EAST AFRICA REGION

S

STRENGTHS

Existing policies and programs from EAC and IGAD related to animal health

Highly competent veterinary and human health workforce

High number of One Health champions associated with AFROHUN

Regional networks for knowledge sharing

Regional laboratory networks

Existing MoUs between countries in region

AMR Surveillance network

W

WEAKNESSES

Porous border crossings, with limited preparedness and protection capacities

Centralization of BSL-3 and BSL-4 labs make remote laboratory access challenging

Limited financial resources for sustainable investments

Reliance on external donor funding for pandemic preparedness and prevention activities

Lack of harmonization among countries on disease management strategies

O

OPPORTUNITIES

Existing and new MoUs between countries for coordinated surveillance

EAC responses to COVID-19, especially at border posts

Strong investment by international donors in laboratory and surveillance capacity

Innovative, decentralized public health laboratory networks offer agility, and could broaden to serve animal and environmental health

Efforts to harmonize RVF control strategies

New generation of One Health champions via AFROHUN

Early warning systems that serve agriculture, water, and disease-related forecasting

World Bank Eastern and Southern Africa One Health Regional Initiative

T

THREATS

Migration of human resources reducing competency and capacity

Inadequate preparedness for disease and food and water security risks linked to climate change on agriculture and livestock conditions and human and animal migration

Extensive number of investments, risking fragmentation and duplication of policies and programs

Complexity of actors in One Health landscape may affect cohesion

East Africa

IGAD Members States signed the Regional Policy Framework on Animal Health in 2009 that focuses on disease control and promotion of trade. IGAD's Centre for Pastoral Areas and Livestock Development has in place a 2017-2022 Animal Health Strategy. It lays out the region's priority diseases: Foot and mouth disease (FMD), Rift Valley fever (RVF), lumpy skin disease, Contagious bovine pleuropneumonia (CBPP), brucellosis, pestes des petits ruminants (PPR), sheep and goat pox, caprine pleuropneumonia (CCPP), camel pox, highly pathogenic avian influenza (HPAI), and Newcastle disease.

The Common Market for East and Southern Africa (COMESA) is a network of 21 African countries that is aimed at harmonizing competitive markets, monetary, banking and financial policies; increasing industrial productivity, agricultural production and food security; promoting rational exploitation of natural resources; and creating reliable transport and communications infrastructure. While health is not necessarily within its purview, COMESA has worked on efforts with Africa CDC around COVID-19 and trade related issues to ensure harmonized messaging across the region.^{7,8}

Regional diseases of concern and relevant risk management measures

Cross-border epidemics in the East African region include Marburg virus disease (Uganda-Kenya border: 2017), Ebola virus disease and pneumonic plague (Democratic Republic of Congo, Uganda: 2019), Cholera, and SARS-CoV-2. Examples of other recent outbreaks in the region include Rift Valley Fever (Kenya: 2021; Uganda, South Sudan: 2018), Crimean-Congo hemorrhagic virus fever (Uganda: 2017–2019), Dengue fever (Kenya, Tanzania: 2017–19), Chikungunya fever (Kenya; 2016 and 2018), Yellow fever (South Sudan; 2018 and 2020), and leishmaniasis (Kenya: 2017).^{9,10}

Several countries have MOUs that could be leveraged to support cross-border collaboration on disease surveillance.

Key drivers of disease are migration, transhumance, animal trade, livestock production, as well as encroachment into wildlife habitat. Transborder movement of livestock and people are prominent in East Africa and are driven by a number of social and economic factors, among them migration, livestock breeding practices, trade, tourism, education, job searching, and healthcare seeking. Many East African borders are porous, with insufficient capacity at border posts, allowing for disease introduction into and movement within the EAC region.¹¹ Migration patterns largely follow the Eastern route, toward the Arabian peninsula, followed by the Horn of Africa route.

Climate change is affecting agricultural production and disease risk in the region. Climate modelling of RVF risk shows high risk of future RVF outbreaks in parts of eastern Africa, such as western Kenya and south-western Uganda, that to date have been unaffected.¹² Previous and ongoing conflict and unrest in Ethiopia and neighboring DRC have at times threatened zoonotic disease preparedness and response. The Horn of Africa is facing a severe drought—potentially the driest conditions in four decades—affecting food insecurity and population displacement.¹³ Climate change is and will likely continue to exacerbate political tension and conflict that have driven the region's large

populations of refugees and displaced persons. Pastoralism is a dominant form of animal rearing in the region, with tensions that climate change will exacerbate as herders and farmers are coming into greater conflict over ever more limited access to natural resources.

Humans are also pushing closer towards natural areas. In Tanzania and Kenya, for instance, human activity at the peripheries of the Serengeti-Mara protected area has limited the area for migrating animals.¹⁴ The presence of domestic animals has resulted in several major disease introductions into endangered wild animals in the region; for examples, rabies virus has affected wild mammal populations including African Wild Dogs and Ethiopian Wolves. Human diseases have also threatened Great Ape populations, particularly through tourism-based wildlife viewing practices.

Regional prevention and control measures

Several regional initiatives are in place for information and surveillance data sharing. The EAC's Disease Prevention and Control Unit coordinates East Africa Integrated Disease Surveillance Network (EAIDSNet) and the East African Public Health Laboratory Networking Project (EAPHLNP).¹⁵ Supported by the Rockefeller Foundation, EAIDSNet is a regional initiative of the national ministries, health research, and academic institutions and is part of the Connecting Organizations for Regional Disease Surveillance (CORDS).¹⁶ CORDS covers Kenya, Rwanda, South Sudan, Uganda, and Tanzania and brings together regional animal and human health surveillance initiatives. EAPHLNP, through funding from the World Bank, developed satellite laboratories at international borders, public health laboratories, and reference laboratories in each East African country, though at present these are not serving animal health functions.

In terms of animal health initiatives, the Eastern Africa Regional Animal Health Network (EA-RAHN) is a platform that brings together Chief Veterinary Officers (CVOs), epidemiologists and laboratory specialists, national Wildlife Authorities, and Ministries of Health to

promote information sharing and strengthen coordination to prevent and control on transboundary animal diseases and zoonoses.¹⁷ It operates in Burundi, Democratic Republic of Congo, Djibouti, Eritrea, Ethiopia, Kenya, Rwanda, South Sudan, Somalia, Sudan, Tanzania and Uganda, in collaboration with FAO, IGAD/ICPALD, EAC, AU-IBAR, AU-PANVAC, ILRI, and WOA. Coordination meetings occur annually.

Several countries have MOUs that could be leveraged to support cross-border collaboration on disease surveillance. For instance, the East African Community's One Stop Border Posts Act of 2016 governs border operations, including surveillance within five countries in the EAC region. MOUs exist between Ethiopia-Somalia (2019) and Djibouti-Ethiopia (2018),^{18,19} where implementation kicked off in December 2021. Some countries have also conducted cross-border simulation exercises. For example, in 2019, WHO and the East African Community Secretariat conducted a field simulation exercise at the Namanga One Stop Border Post between Kenya and Tanzania that involved multiple sectors (health, tourism, livestock, and environment).²⁰

Many prevention and control measures are ad-hoc missions or projects supported and/or implemented by external partners (see Box). These projects are often focused on short-term mass vaccination campaigns or developing laboratory or surveillance capacity. Several projects are attempting to coordinate diagnostic capacity in the region. For instance, EAC with the support of the German Development Bank have established mobile laboratories in settings where reliance on centralized laboratories has led to diagnostic delays.²¹ In 2019, FAO established an AMR surveillance network, encouraging country commitment on advancing collaborative surveillance, a One Health AMR platform, and a Technical Advisory Group in East Africa.²²

FAO also established two regional networks to coordinate animal health work in the region—the Eastern African Epidemiology Regional Network and the Eastern Africa Regional Laboratory Network.²³

East Africa

These centered on FMD despite having launched within a broader scope. FAO is also leading a regional initiative to harmonize RVF control strategies in the region, with regards to vaccine type, quality and safety as well as the establishment of regional reference laboratories and sentinel herds. A regional plan of action was developed at a high-level meeting in Tanzania in 2018.

Regional training pipelines and research collaborations

The Africa One Health University Network (AFROHUN), has its headquarters in Kampala, Uganda. The network currently includes eleven universities in the region, in Ethiopia, Kenya, Rwanda, Tanzania, and Uganda. EAC, with the support of GIZ, has also been involved in One Health curricula development, launching a post-graduate course on “Pandemic Preparedness with a One Health Approach” in 2020 with potential to become a full diploma offering.²⁹

East Africa is home to many veterinary schools (though unevenly distributed across the region). The University of Zambia’s School of Veterinary medicine hosts the

Box: Externally supported One Health activities in the region (examples)

Support to Pandemic Preparedness in the EAC Region: GIZ is supporting EAC regional preparedness and response capacity to potential pandemics. They advise the EAC on One Health integration and have supported cross-border field simulation exercises led by WHO.

East Africa Public Health Laboratory Network (EAPHLN): World Bank supported the development of 25 satellite laboratories along the border areas of EAC member states and a network of 41 public health laboratories in Kenya, Uganda, Tanzania, Rwanda, and Burundi.²⁴ In each country, EAPHLN includes a central reference laboratory and satellite laboratories mostly in border areas. More than 19,000 health personnel were trained.²⁵

Mobile Laboratories: EAC is working with the German Development Bank and the Bernhard-Nocht-Institute for Tropical Medicine in establishing nine mobile BSL-3 and BSL-4 laboratories in the region. The units have been deployed.

Capacitating One Health in Eastern and Southern Africa: ILRI, CIRAD, and ISAAA are leading on a 4-year EU-funded project in Ethiopia, Kenya, Rwanda, Tanzania, and Uganda to improve the policy relevance of One Health research, cross-sectoral collaboration, the One Health workforce, and the implementation of One Health approaches.^{26, 27}

Sustainable Operationalization of the One Health in the Africa Region: FAO is working in Ethiopia, Kenya, and Tanzania to pilot a One Health joint-risk assessment tool with funding from DTRA.²⁸

Better Enforcement of Standards for Safe Trade: This WOAHI initiative is supporting public-private partnerships that improve compliance with WOAHI international standards and safe trade of livestock and livestock products between the Horn of Africa and the Gulf States.

African Center of Excellence for Infectious Diseases for Human and Animals (ACEIDHA), which aims to develop research capacity and academic training on zoonotic diseases. A 2018 paper found that research on zoonotic diseases in the region has increased exponentially over the last decade. Endemic diseases were the most studied topic. More studies employed epidemiological methods, while social and economic research was more limited.³⁰ Several organizations in the region are supporting and undertaking collaborative One Health research. Focused on food security, the International Livestock Research Institute (ILRI) has a robust East African presence. Animal and human health constitutes one of its research themes, with specific work on the control of zoonotic diseases. ILRI is also a partner in the One Health Regional Network for the Horn of Africa (HORN), a partnership led by the University of Liverpool in partnership with Liverpool School of Tropical Medicine and in collaboration with the University of Addis Ababa, IGAD Sheikh Technical Veterinary School, Hamelmalo Agricultural College, among others. HORN is working to improve One Health research capacities in the region and launch a One Health Regional Network to provide research sharing.

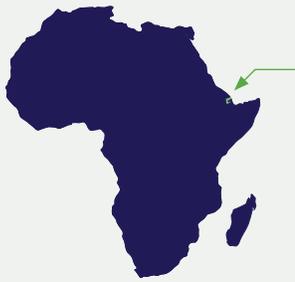
REGIONAL PRIORITIES AND COMMITMENTS

Indications of interest and commitment to take on One Health and veterinary programs and systems strengthening

A 2020 review of One Health initiatives in sub-Saharan Africa found that the majority of initiatives (over 100) were located in East Africa.³¹ This is indicative of the regional and national interest in One Health coordination. It also signals the need for targeted and systematic investments that build upon existing initiatives to prevent fragmentation and potential duplication of resources.

Opportunities to leverage regional COVID-19 activities

Operations under the One Stop Border Posts Act, including surveillance within the EAC region, were leveraged to support training and personnel to prevent cross-border spread for Ebola and COVID-19 more recently.³² In response to COVID-19, EAC launched a digital surveillance tracker, the Regional Electronic Cargo and Drivers Tracking System, to connect to laboratories and share COVID-19 testing data. Some laboratories under the EAC's Mobile Laboratory Project have been mobilized for COVID-19 screening, but are intended as long-term resources to provide agility for detection and response to infectious diseases in general. The laboratories have been deployed to five countries in the region (one each in Rwanda and South Sudan, and two each in the Kenya, Uganda, Tanzania). One has also been located in Burundi. Training has accompanied the deployment of the laboratories,³³ including for laboratorians, engineers to support equipment maintenance, and drivers involved in the transport of the units. In addition, Kenya has been selected to receive capacity development support through the mRNA Technology Transfer Hub, which seeks to accelerate vaccine production capabilities.



Djibouti

Completed Assessments and Plans

JEE	PVS Evaluation	PVS Evaluation Follow-Up	PVS Gap Analysis	PVS Legislation	IHR-PVS Bridging Workshop	NAPHS	OHZDP	National AMR Action Plan	NBSAP
2018	2007	-	2009	2016	-	-	-	-	2017

Indicator	Country	Region Average	Continent Average
Coordination and Financing			
Multi-sector and One Health collaboration/coordination for AMR (1-5)	1.00	2.25	2.44
Collaborative effort on activities to address zoonoses (0-100)	40.00	54.12	54.23
Current health expenditure per capita (USD)	61.81	130.86	132.25
CFE disbursements (USD)	0.00	1,742,137.45	4,903,032.44
Workforce			
Veterinarians (total)	143.00	3,097.00	3,512.00
Veterinarians (per 1,000 people)	0.15	0.16	0.17
Public animal health professionals (total)	10.00	212.00	461.00
Public animal health professionals (per 1,000 people)	0.01	0.01	0.02
Medical doctors (total)	201.00	3,311.00	8,574.00
Medical doctors (per 1,000 people)	0.22	0.42	0.41
Up-to-date multisectoral workforce strategy (1-5)	1.00	2.33	2.19
Progress with strengthening veterinary services (1-5)	1.00	2.62	2.80
Demographic Factors			
Population (total)	973,557.00	24,025,701.94	24,185,802.76
Population growth (% ,2010-2019)	15.90	23.76	23.73
GNI per capita (USD)	3,310.00	2,517.78	2,525.37
Environmental and Sanitation Factors			
Land area (sq km)	23,180.00	378,644.97	548,414.71
Arable land (% land area)	0.09	18.53	14.14
Forest area (% land area)	0.25	24.89	27.57
Terrestrial protected areas (% land area)	1.57	17.04	16.27
Average primary forest loss (ha)	—	6,271.69	20,326.14
Access to basic drinking water — rural (%)	47.10	49.58	55.48
Access to basic drinking water — national (%)	75.60	63.02	69.76
Access to basic hygiene — national (%)	—	18.18	26.71
Access to basic sanitation — national (%)	63.60	35.66	40.71
Animal Factors			
Average livestock stocks (LSUs)	318,654.61	6,601,349.50	5,551,123.37
Average livestock exports (LSUs)	61,856.21	44,401.60	33,314.93
Average livestock imports (LSUs)	9,831.93	12,869.29	31,044.50
Mammal species (number)	125.00	240.61	241.65

STATUS OF ONE HEALTH AND VETERINARY SYSTEMS

The Ministry of Health is responsible for public health, including pharmaceutical policy, epidemiological surveillance, and health monitoring through the National Institute of Public Health (INSPD). It designs and implements the government's policy on health coverage. It is responsible for the elaboration, follow-up, and updating of the national health map and oversees priority health actions in the curative field as well as in the fields of prevention, re-education, and recovery.

The Ministry of Health defines and monitors training programs for health personnel and draws up the list of establishments whose diplomas entitle them to practice a health profession in the Republic of Djibouti. It oversees the control and regulation of health professions, pharmacies, and private health structures in collaboration with the National Order of Medical Professions. In the current state, there is little systematic intersectoral collaboration between the three different ministries; each working in silos. In 2020, the government launched the National Health Development Plan for 2020-2024 with four key components, namely: expanding quality care in all regions, reducing regional disparities, strengthening health financing and the Health Management Information System, and reducing the prevalence of diseases.

In practice, the Ministry of Health (human) and The Ministry of Education have priority over the Ministry of Agriculture and the Ministry of Environment, which impedes good veterinary governance. The country is subdivided into 5 decentralized regions. There are 3 central directorates for each Ministry in the capital but there are branches in the 5 regions of the country. The Ministry of Health extends to many structures spread across the country (hospitals, laboratories, health centers). The main health centers are located in the capital.

The Ministry of the Environment and the Directorate of Environment and Sustainable Development (DEDD) are responsible for developing and implementing

government policy in the field of environmental management. In addition, a Ministry of Decentralization in charge of Regional Development has been created. The Regional Network under the Intergovernmental Authority on Development (IGAD) and the Djibouti DEDD with external funding are involved in wildlife epidemiological surveillance (e.g. for PPR, HPAI).

The Executive Secretariat for Risk and Disaster Management, under the Ministry of the Interior, and the National Meteorological Agency, under the Ministry of Infrastructure and Equipment, are mandated to monitor and coordinate natural disasters. Several recent events have included public health emergencies and livestock losses, linked to drought and flooding.

The Ministry of Health convenes the Task Force for Pandemic Avian Influenza, a multisectoral committee of technical experts with representatives from several ministries and other partners. This mechanism supports coordination, management, and control of avian influenza. However, there has not been an analysis of influenza-like illness trends in Djibouti. The Ministry of Agriculture, Water, Fisheries, and Livestock, in charge of Fisheries Resources (MAEPE-RH) oversees: animal production, veterinary and food control, fisheries production, plant production and improvement of plant cover, study and exploitation of water resources at the rural and urban levels, design and construction of surface waterworks and access roads to waterworks, and preparation and control of sanitation policy.

The Directorate of Livestock and Veterinary Services (DESV) within the Ministry of Agriculture and Livestock deals with all matters relating to the organization and development of crop production and the fight against desertification, animal production and health, veterinary and food controls. At present there are 25 veterinarians in the public sector, 15 in the private sector, which are mainly employed by the quarantine service, and 45 para-veterinarians. The geographical distribution of available human resources and the range of specialties covered need to be improved. DESV has limited capacity in terms of operating budget, equipment, and materials and the distribution of staff

S

STRENGTHS

National plans and programs for surveillance and control of both human and animal diseases

Well-structured and efficient livestock trade facilities and infrastructure

Importation, sale, and marketing of medicines under the control of the State (Ministry of Health, Ministry of Agriculture)

Control on the quality of, import and sales of drugs by the Ministries of Health and Agriculture

Regional exchange with Ethiopia

Wildlife disease surveillance and detection in collaboration with IGAD

Six priority diseases have been identified

Military cooperation and partnership agreements with France and the United States in the animal or human health sector

Protocols or agreements signed and implemented between Djibouti and countries with which it trades including in the management of animal diseases

W

WEAKNESSES

Inter-sectoral communication and information exchange often poorly structured

No One Health strategy in place

Lack of harmonization and coordination at national and regional levels on zoonotic disease control programs

Lack of technical capacity for systematic AMR detection and monitoring

No National Action Plan for AMR, with a resultant low level of implementation

Poor animal welfare, especially for camels

Weak organization of pastoralists and agro-pastoralists

No initial or continuous training for veterinary workforce; Continuing education and specializations not available at the national level

No training and capacity reinforcement for veterinarians and para-veterinarians in disease detection

Low capacity of veterinary services due to limited financial resources

Legal framework governing the livestock sector defined and updated but not yet made official

O

OPPORTUNITIES

Existence of an intersectoral coordination committee for the fight against avian and human influenza

Regional, continental, and international awareness on the importance of preserving animal and human health and working towards sustainable development

National policy to encourage investment in the agricultural sector and agribusiness

Willingness to establish a One Health platform

Regional quarantine station conducting disease screening in line with One Health approach

T

THREATS

Risk of introduction of transboundary animal diseases, invasive species, or zoonotic diseases not negligible due to nomadism and trade

Low accessibility of rural populations to public services (veterinary support, health, education)

Low level of integration of the livestock sector into national development policies

High dependence of the animal health sector on external resources and international providers (drugs and diagnostic supplies)

according to branches and positions in the different regions of the country is ad hoc.

There is a livestock marketing association and a butchers' syndicate; the country is famous for its regional livestock quarantine station. The quarantine center has a filling capacity of 250,000 heads at a time (camels, cattle, small ruminants). The center is located 15 km from the capital, near the seaport. The management is private but the control and the sanitary certification of the livestock are carried out by public veterinarians mandated by the State of Djibouti.

A series of projects and programs in the field of public, veterinary and environmental health, and climate change resilience are supported and funded by USAID, GIZ, FAO, UNICEF, the European Commission, the World Bank, WHO, French Facility for Global Environment, French Cooperation, and Italian Cooperation, among others. Several of these programs started between 2012 and 2014; however, they do not include a sufficient component in the field of animal health. Only the FAO SHARE project and the AU-IBAR Surveillance of Trade Sensitive Diseases project funded by the European Union (EU), and the AU-IBAR Standard Methods and Procedures in Animal Health project funded by USAID have contributed to the strengthening of the capacities of veterinary services related to animal disease control.

One Health Coordination

There is no formal One Health platform in Djibouti. The country lacks a dedicated One Health strategy. There is no inter-sectoral committee for the control of zoonotic diseases and collaboration between human and animal health has yet to be institutionalized. There is limited multi-sectoral coordination among agencies. In 2007, the MAEPE-RH set up a tripartite committee, a Task Force for the avian influenza pandemic. This committee, formalized by Presidential Order, includes the Ministry of Agriculture, the Ministry of Health, and the Ministry of the Environment.

Djibouti is included to some extent in One Health capacity strengthening and research programs such as

the Field Epidemiology Training Program (via AFENET) and the One Health Regional Network for the Horn of Africa focusing on animal and public health, social science, and livelihoods (though not as a formal partner country). Implementation of the National Action Plan for Health and Security (2019-2023) has been hindered by lack of financing. A point of entry to initiate discussions on the One Health platform in Djibouti could be inspired by the COVID-19 response. For example, in 2020 an Epidemic Management Committee (CGE) was quickly established with the support of the World Bank by the Ministry of Health and consisted of multiple stakeholders and representatives from several ministries that united strengths to control the disease.

There is a Djibouti-Ethiopian joint commission with a technical component held every six months and a political component held annually. The technical meetings bring together the joint committee of technical officials and administrators of the border regions of the two countries. The topics of discussion are subjects of common interest such as animal and human health, trade, immigration, and border security. These meetings typically last 3 to 4 days and alternate the location between the two countries. The technical meeting is chaired by the Ministry of the Interior, the annual meeting by the Minister of Foreign Affairs. The Ministry of Interior and the Ministry of Foreign Affairs have signed an MOU for bilateral collaboration mostly related to disputes that may arise on migration and trade issues, less so on the issue of disease monitoring. They meet annually to establish better collaboration on migration and trade (e.g. immigration) related matters. The two countries hold joint technical meetings every three months, culminating in an annual Ministerial meeting.

Training Pipelines

There is one national university in Djibouti (Djibouti University), which has a Faculty of General and Human Medicine. It does not have a faculty of veterinary medicine (there is no veterinary school in the country), but there is a technical institution under the Ministry of Education which trains farmers and certificate level

students in agriculture, fisheries, and livestock. The majority of veterinarians in Djibouti have been trained at the EISMV in Senegal and must therefore find funds to be trained abroad. Still, most if not all in-country veterinarians are Djiboutians. A Regional School for Agricultural Training and Rural Development and the primary sector has been recommended but does not yet exist. According to the PVS (2007), the initial training of para-veterinarians is insufficient, along with continuing education for veterinarians, particularly in zoonotic disease surveillance and control. Initial and continuous training are conducted on an ad hoc basis, often depending on opportunities offered by international programs (see Box on projects and initiatives). There is no officially defined strategy or planning for continuing education or specialization. Climate change and the globalization of trade justify the need for retraining and continuing education for veterinarians, because of their transversal role. There is no veterinary regulatory body or professional association and no robust livestock research in the country.

DISEASE MANAGEMENT

Surveillance and Reporting

The country has no specific surveillance system for zoonoses. However, it does have a response system through the establishment of ad-hoc intersectoral committees (e.g. Avian Influenza Control). The surveillance system is based on mandatory reporting of 20 infectious diseases and syndromes. These 20 notifiable diseases include 4 zoonotic diseases or disease groups: hemorrhagic fevers (such as Rift Valley fever, Congo-Crimean fever), severe acute respiratory syndromes (highly pathogenic avian influenza, Middle East Respiratory Syndrome Coronavirus or MERS-Coronavirus), brucellosis, and rabies. In 2015-2016 using the WOAHP tool the country identified and categorized 15 diseases based on their potential impact (economic, human health, societal, environmental).

PPR, CCPP, RVF, brucellosis, CBPP, camel pox, sheep and goat pox, and foot and mouth disease are identified as priority diseases and are reported through the WOAHP WAHIS platform. The country has surveillance protocols for the 9 transboundary diseases established under the Standards Methods and Procedures in Animal Health and the Surveillance of Trade Sensitive Diseases projects. According to the JEE (2018), unknown or emerging events, some of which may be of zoonotic origin, are reported.

The surveillance system relies on syndromic surveillance for influenza-like illness using the routine surveillance system and notifiable disease procedures, without specific case definitions. Epidemiological surveillance is mainly passive for tuberculosis, hydatidosis, and cysticercosis during post-mortem inspection at slaughterhouses. It is active for Rift Valley fever (during risk situations; when outbreaks occur in the larger region and threaten the country) and brucellosis, which is systematically tested at the Damerjog quarantine station on livestock in transit. Surveillance data are included in the DESV report, but are not shared with the Ministry of Health, except during important events (e.g. during a health crisis due to an emerging or re-emerging zoonotic disease such as HPAI). Investigations in livestock are conducted by DESV.

Dissemination of epidemiological reports at the regional and sectoral levels needs to be enhanced to support real-time and routine information sharing. There are no legal frameworks, procedures, or best practice guides to coordinate zoonotic disease surveillance activities between animal and human health sectors. Operational procedures specifying mechanisms for coordination between sectors and validation of notifications to WHO and WOAHP would improve the country's reporting capacity, which remains limited.

In 2013, a workshop on surveillance and the new list of notifiable human health-related diseases was held with the participation of 40 chief medical officers, nurse majors, and program managers who validated the new list and developed the process for disseminating



- Two-thirds of population in low-lying coastal capital city; access to rural community limited by poor conditions
- Human migration through/into the country, and internal displacement from drought events
- Major entry point to/from Africa, with high volume of formal and informal livestock (particularly camels) transiting through country
- Invasive mosquitos linked to marked increase in malaria incidence
- Water insecurity, particularly with no permanent surface water source and impact of invasive mesquite trees, and high incidence of water-borne diseases
- Well-preserved reefs, but overfishing, coastal pollution from shipping sector, and mangroves threatened by livestock overgrazing and oil spills

information. The workshop did not involve veterinarians. In 2015, a community-based disease reporting system in Djibouti was discussed at a workshop held by the Standard Methods and Procedures in Animal Health project. The community-based disease reporting system was introduced to 56 stakeholders in Djibouti from the livestock sector, including farmers, representatives of farmers-livestock associations, auxiliary veterinarians, and veterinary technicians from the capital and the interior, private veterinary practitioners, and AU-IBAR.

Despite being detected elsewhere in the sub-region, RVF outbreaks have not been seen in the country for over three decades. An annual sentinel surveillance program in livestock was initiated under a long-term cooperation between the Directorate of Veterinary Services and the health services of the French Army. Screening was initially conducted at the former “Bouffard” military hospital, transitioning to the veterinary laboratory in the DESV in 2004. This work has linked to FAO regional risk assessments and collaboration, and in April 2015 an inter-regional conference was held in Djibouti on “Rift Valley Fever: new options for trade, prevention, and control”.

Access to Diagnostics and Vaccines

Diagnostics

According to the JEE (2018), the national human and animal health laboratory system has the expertise and capacity to perform key tests for priority diseases at the central level. The main veterinary laboratories are the Djibouti Center for Studies and Research (CERD), the National Laboratory for Food Analysis (LANAA), the Laboratory for Diagnosis of Animal Diseases (LDMA; BSL-2), and the laboratory of the quarantine center (WOAH Reference Laboratories). The LDMA is competent for all serology mainly by ELISA method, as well as blood parasitology. A PCR room is being installed within the laboratory. At the level of human medicine, the main laboratories are those of the Peltier Hospital, Paul Faure (BSL-2), Bouffard Molecular Biology (BSL-2), and the INSPD (BSL-1). The INSPD laboratory is composed of 4 services (virology, bacteriology, and entomology/parasitology, and environment and toxicology).

Vaccination

Djibouti does not have facilities currently producing its own animal or human vaccine. The main sources of vaccines are WHO and FAO. The State of Djibouti buys the vaccines and ensure storage, cold chain, and vaccination campaign) except when it is a donor-funded

program. The pharmacies sell vaccines to private veterinarians. The State of Djibouti buys its vaccines using its own funds (national budget) and the private manager of the quarantine center orders the vaccine and purchase them; breeders pay for the vaccination of their animals. There is a Central Procurement Agency for Essential Medicines and Materials.

PREVENTION AND CONTROL MEASURES

The country launched its Expanded Program on Immunization (EPI) in 1984. Its 2016-2020 comprehensive plan is aligned with the WHO's global vaccine action plan and covers 10 vaccine-preventable diseases in humans. One challenge continues to be vaccination in rural areas and among nomadic and refugee populations. The management of people bitten by dogs and rabies surveillance is operated through a referral center of the INSPD (National Institute of Public Health of Djibouti) which is a branch of the Ministry of Health tasked with the epidemiology and management of zoonoses. The INSPD prescribes the post-exposure vaccine in case of high suspicion of rabies based on the behavior of the animal that bit the person; however, obtaining it requires private purchase at a pharmacy. An anti-tetanus serum is prescribed systematically for bite victims.

There is no national animal health vaccination program. Under the Pan-African Rinderpest Campaign and Pan-African Control of Epizootics programs livestock have been vaccinated against rinderpest and CBPP for over a decade. In 2007, the goat population of the Tadjourah region was vaccinated against brucellosis with the REV1 vaccine provided by FAO. A PPR prevention strategy has been implemented since 2017, with a vaccination program under way, linked to the FAO-WOAH global strategy for eradication of PPR by 2030. Vaccination campaigns are undertaken by the Government of Djibouti with the technical support of FAO. Implementation has been slowed due to COVID-19.

Box: Projects and Initiatives in Djibouti

VETGOV — A five-year programme launched in 2012 to strengthen veterinary governance in Africa and led by AU-IBAR.

Eastern Africa Regional Laboratory Network (EARLN) — Brings together staff from the regional laboratories working on different diseases to enable collective understanding of laboratory issues relating to the diseases and share knowledge, information, and techniques.

Eastern Africa Regional Epidemiological Network (EAREN) — Funded by USAID and the European Commission and supported by FAO-ECTAD bringing together national epidemiologists to foster the exchange of epidemiological information essential to the Veterinary Services for a regional approach to priority disease control.

IDENTIFY-AFRICA — Funded by USAID, this joint FAO/WOAH/WHO project aims to strengthen the capacity of laboratories in the human and animal health sectors for rapid and accurate detection of pathogens and appropriate handling of material from clinical cases in order to contribute to the management of normative and emerging zoonotic microorganisms.

DECAN and Djibouti Nature — The DECAN association has created the DECAN refuge for the protection of cheetahs (a seriously threatened species) and other wild animals, and have created two official new protected areas in Djibouti.

Djibouti's hosting of the first regional quarantine center was linked to its port and banking facilities, political stability, and location, particularly near major importers from the Middle East. The quarantine center is managed as a public-private institution. A challenge for disease prevention and control is that the various importing countries have different health requirements for the same disease. For example, while some countries require vaccination, others require a test and slaughter policy for the same disease.

Djibouti also hosts several partner military bases and has military cooperation agreements with France and the United States in the animal or human health sector. Practical exercises are often conducted that cut across aspects of human, animal, and environmental health (and can reinforce a One Health approach). For example, in 2020 and 2022 U.S. Army Civil Affairs units conducted veterinary civic action programs (VETCAP) with the Djiboutian Ministry of Agriculture, Livestock and Fisheries, bringing veterinary services to rural villages and liaise with community animal health workers. In one of these missions, over 1,000 animals were treated for parasites and administered disease treatment; the program also included tick and stool sample collection for disease screening, contributing to overall detection efforts.

To date, Djibouti has not developed a national action plan on AMR, and there is limited implementation of AMR-related activities. However, the country has regulations for the prescription and resale of antimicrobials for human use.

ETHICS

Animal welfare issues in the Horn of Africa are recognized as needing regional attention. One key welfare concern is the transport of animals routed via Djibouti for livestock trade. Inadequate holding conditions (including space constraints and limited biosecurity) present a problem, particularly on shipping vessels used for the camel trade, resulting in reported animal injuries and illness. While there is a Human Ethical Review Committee at the National Institute of Public Health (INSP), there is no parallel committee for review of research activities involving animals.

DJIBOUTI CASE STUDY

Brucellosis

CURRENT SITUATION

Brucellosis, a bacterial disease with six main species (*B. abortus*, *B. melitensis*, *B. suis*, *B. ovis*, *B. canis*, *B. neotomae*), causes infection in a variety of terrestrial and marine mammals. Clinical cases in livestock are often missed, with detection of outbreaks typically occurring in human cases from contact with infected materials, blood, or aerosol droplets when handling an infected animal, its products, or abortion. The main source of contamination is consumed milk. The preference for fresh, unheated milk is linked to ancestral culture and nomadism. However, the use of charcoal to heat milk has a negative impact on the environment, especially in rural areas; alternatives or other sources of energy must be made available. A One Health approach is warranted to address epidemiological, environmental, and socio-economic dimensions of brucellosis.

Human and animal Brucellosis is endemic in Djibouti and has an impact on both human and animal health and the economy of affected households.^{34,35}

Brucellosis is a contagious disease of livestock with a significant economic impact, which has not been quantified to date. Nevertheless, despite the lack of systematic surveillance, it seems that the prevalence rate is the lowest in the sub-region, estimated at approximately 1%, with an increasing prevalence in order of importance in camels, goats, and cattle.

Brucellosis has always been a major concern because of its impact on human health as a dangerous zoonosis that is difficult to diagnose easily, control effectively and treat. Between 1993 and 1995, following a retrospective survey carried out at the Peltier General Hospital in the capital Djibouti, 42 human cases were diagnosed (30 men and 12 women). The 15-50 age group was most frequently affected by human brucellosis in Djibouti (mean age 31.6 years).

An outbreak was detected in February 2001 as part of routine surveillance by the Directorate of Livestock and Veterinary Services (DESV). The outbreak occurred on a dairy cattle farm on the outskirts of the capital. The

Rose Bengal test revealed 4 positive cows out of a herd of about 20 head, subsequently confirmed by the Wright serological test at the former French “Bouffard” military hospital. The sanitary and hygienic measures recommended by WOA and FAO were applied, and the human case was taken care of by the Ministry of Health. There has been no recurrence of cases in this farm since then.

In 2013, a doctoral thesis attempted to determine the prevalence of animal brucellosis (cattle, small ruminants, and camels) in the country. Of all samples (852 sera), 10 were positive on Rose Bengal, giving a prevalence of ~1.17%. No sheep were found positive; the prevalence was 1.88% in cattle, 1.34% in goats, and 0.44% in camels. Three regions showed positive cases: Tadjourah, Obock, and Arta. The prevalence is, therefore, low based on this sample and the diagnostic techniques used. In 2015, out of 150 samples tested with the Rose Bengal test, no positive cases were revealed.

National serological surveys have been undertaken throughout the country by the DESV with the support of regional programs financed by the EU and executed

by FAO or AU-IBAR. In 2016, 0.32% positive samples out of 2,280 samples of domestic animals, mostly small ruminants, were detected. In 2018, 1.2% positive samples were detected out of 1,077 small ruminants sampled. In 2021, 0.3% positive samples were reported in small ruminants, 3% in cattle, and no cases in camels. No cases of brucellosis have been reported in Djibouti in wildlife.^{36,37}

HIGH-LEVEL STRATEGIES

The Joint External Evaluation for Djibouti (JEE), conducted in July 2018, noted the absence of any national legislation, procedures, or good practice guidance to coordinate zoonotic disease surveillance between the animal and human health sectors. Nevertheless, Djibouti has experience in brucellosis surveillance and two laboratories; the Djibouti Center for Studies and Research (CERD) and the National Laboratory for Food Analysis (LANAA) have diagnostic capacity in veterinary and animal quarantine. There is no common strategy, platform, or One Health plan to control brucellosis. The Ministry of Agriculture and the Ministry of Health each have their own official protocol for surveillance and control of the disease. It is a major zoonosis, but above all an occupation-related concern, with a higher risk for people working on farms, livestock markets, or meat production establishments. Brucellosis is treated in the same way as other diseases, without a systematic procedure for joint action (including in epidemiological investigation) when cases are identified.³⁸ However, since 2005, Djibouti has been reporting about 20 cases of human brucellosis every year, with index cases identified.³⁹

SURVEILLANCE

Surveillance is both active and passive. It takes place throughout the country. Livestock farmers, basic animal health auxiliaries, and local authorities have been sensitized and are part of the surveillance system to report disease outbreaks. Diagnosis using serological tests (Rose Bengal test, ELISA) as well as milk tests

such as the colored ring test can be used to detect the disease and play an important role in campaigns to eliminate it. Animals can be tested individually for both prophylactic and commercial purposes as is the case at the quarantine center level. However, the capacity for molecular testing, culture, or sequencing in the country for *Brucella* spp. is still under development. A national laboratory for animal disease diagnosis was established in 2004 through the Pan-African Control of Epizootics/European Union program and strengthened by the SPINA-AH1 project in 2007. The National Veterinary Laboratory within the Ministry of Agriculture of Djibouti's Directorate of Livestock and Veterinary Services is part of the third phase program of the technical assistance project to the Djibouti Agriculture Experts Team, supported by China. As of now, with the normal function of the laboratory's various instruments, the diagnosis of animal diseases by PCR could be launched. The laboratory has diagnosed 21 positive cases of brucellosis out of 1,814 animals (sheep, goats, cattle, camels) attending the central veterinary clinic in the capital between 2010-2014.

PREVENTION AND CONTROL

The Veterinary Services are responsible for the prevention, monitoring, surveillance, and control of Brucellosis and notify WOAHA of cases. International standard measures are implemented under the aegis of FAO and WOAHA and support the country through the Directorate of Veterinary Services to put in place measures to control the disease; namely: active surveillance, screening, and stamping out; vaccination of humans and animals in endemic areas, if vaccine is available; systematic pasteurization of raw milk: heating to 70 percent without boiling; avoid careless handling of animals in case of abortion; and masks, gloves, and protective clothing in case of stamping out of an infected animal.

Brucellosis

REGIONAL CONSIDERATIONS

Brucellosis is one of the 9 priority diseases identified and adopted by African countries in 2013 under the aegis of AU-IBAR, in partnership with WOAHA and FAO. At the regional level, the AU-IBAR/FAO control strategy is in place. A strategy also exists to combat transboundary diseases that hamper livestock trade in IGAD member countries. Saudi Arabia, the main importer of livestock from East Africa, requires systematic brucellosis testing of livestock exported from Djibouti at the Damerjog quarantine center (a 100 percent negative test). However, formal and informal cross-border trade represent an unassessed risk of disease introduction. In the region, this informal flow may account for a substantial portion of livestock entering local trade or live export.

IMPLEMENTATION GAPS

The limited budget of the DESV gives rise to several constraints such as the weak structuring of livestock farmers' groups for the marketing of livestock products, the deterioration of infrastructures such as veterinary posts and slaughter areas, the inadequacy of material and equipment (logistics, veterinary inputs, laboratory consumables), and infrastructure for the reception of animals (livestock park, pre-quarantine). Deficiencies identified include:

- Insufficient overall operating budget for veterinary services
- Lack of collaboration between veterinary and public health services, except in case of a health crisis
- Low number of veterinarians indicates livestock are not prioritized
- Lack of legal framework specifying the terms of collaboration and consultation

- Lack of compensation policy, as owners of affected animals do not accept stamping out without compensation
- Health risks associated with cross-border livestock movements, which are difficult to assess due to nomadic movements
- Weak systematic reporting and communication system from the periphery to the central level for brucellosis control.

KEY RECOMMENDATIONS

- Update and complete the legislation by bringing it into line with the new One Health concept, in particular in the form of a national contingency plan for control and a joint Ministry of Health — Ministry of Agriculture — Ministry of the Environment platform with a precise definition of the tasks and methods of collaboration
- Strengthen veterinary services in terms of training, equipment, laboratory diagnosis, operation
- Define and implement compensation measures in the event of stamping out.
- Assess the relevance of a vaccination program on animals, on humans, or both
- Create regional cooperation structures with communication and information exchange mechanisms.

Ethiopia



Completed Assessments and Plans

JEE	PVS Evaluation	PVS Evaluation Follow-Up	PVS Gap Analysis	PVS Legislation	IHR-PVS Bridging Workshop	NAPHS	OHZDP	National AMR Action Plan	NBSAP
2016	2011	-	2012	2015	2018	2018	2015, 2019	2015	2016

Indicator **Country** **Region Average** **Continent Average**

Coordination and Financing

Multi-sector and One Health collaboration/coordination for AMR (1-5)	3.00	2.25	2.44
Collaborative effort on activities to address zoonoses (0-100)	60.00	54.12	54.23
Current health expenditure per capita (USD)	26.74	130.86	132.25
CFE disbursements (USD)	3,867,502.00	1,742,137.45	4,903,032.44

Workforce

Veterinarians (total)	11,731.00	3,097.00	3,512.00
Veterinarians (per 1,000 people)	0.11	0.16	0.17
Public animal health professionals (total)	710.00	212.00	461.00
Public animal health professionals (per 1,000 people)	0.01	0.01	0.02
Medical doctors (total)	8,395.00	3,311.00	8,574.00
Medical doctors (per 1,000 people)	0.08	0.42	0.41
Up-to-date multisectoral workforce strategy (1-5)	3.00	2.33	2.19
Progress with strengthening veterinary services (1-5)	3.00	2.62	2.80

Demographic Factors

Population (total)	112,078,727.00	24,025,701.94	24,185,802.76
Population growth (% ,2010-2019)	27.90	23.76	23.73
GNI per capita (USD)	850.00	2,517.78	2,525.37

Environmental and Sanitation Factors

Land area (sq km)	1,129,300.39	378,644.97	548,414.71
Arable land (% land area)	14.33	18.53	14.14
Forest area (% land area)	15.18	24.89	27.57
Terrestrial protected areas (% land area)	17.62	17.04	16.27
Average primary forest loss (ha)	4,630.76	6,271.69	20,326.14
Access to basic drinking water — rural (%)	31.10	49.58	55.48
Access to basic drinking water — national (%)	41.10	63.02	69.76
Access to basic hygiene — national (%)	8.00	18.18	26.71
Access to basic sanitation — national (%)	7.30	35.66	40.71

Animal Factors

Average livestock stocks (LSUs)	36,203,413.62	6,601,349.50	5,551,123.37
Average livestock exports (LSUs)	138,323.67	44,401.60	33,314.93
Average livestock imports (LSUs)	1,879.07	12,869.29	31,044.50
Mammal species (number)	363.00	240.61	241.65

STATUS OF VETERINARY AND ONE HEALTH SYSTEMS

Under the Ministry of Health (MOH), the Ethiopian Public Health Institute (EPHI) oversees the Center for Public Health Emergency Management (PHEM), Research & Technology Transfer Directorate and the National Laboratory Capacity Building pillars. The Center for Public Health Emergency Management (PHEM) is tasked with rapid detection of public health threats, preparedness in relation to logistics and administration of funds, and public health emergency response and recovery, with a scope ranging from infectious diseases, bioterrorism, nutritional emergencies to hazardous chemicals. The PHEM aims to reduce disease burden from public health emergencies and minimize negative social and economic consequences. Zoonotic disease and food safety are under the research and technology wing. The laboratory capacity building pillar is responsible for building a quality laboratory system. The Ethiopian Food and Drug Authority is also under the MOH, responsible for setting and enforcing drug and food safety standards and regulations. The Armauer Hansen Research Institute (AHRI), under the MOH since 2004, first established as a biomedical research institute specialized in leprosy, has a mandate to conduct research on priority infectious diseases including zoonoses.

Together with MOH, the Ministry of Agriculture is in charge of formulating policies and programs on zoonoses and AMR. It oversees the Animal Health Institute (AHI), the referral and reference veterinary laboratory. AHI also provides technical support to regional veterinary laboratories. The Ethiopian Agricultural Authority (EAA) is responsible for developing and implementing a strong regulatory system in the agricultural sector to increase international and national competitiveness, reduce or eliminate harmful effects on the environment and

community health. The Ethiopian Biodiversity Institute (EBI) is mandated with the conservation and sustainable use of biological resources including plants, animals and microbial genetic resources and associated indigenous knowledge.

The Ethiopian Wildlife Conservation Authority (EWCA) within the Ministry of Tourism (MOT) is legally responsible for 11 national parks and 2 wildlife sanctuaries, regulating hunting, and protecting biodiversity. It provides technical and financial support for regions to enhance wildlife conservation activities on protected areas. The Ethiopian Environmental Protection Authority (EEPA) has a mandate for environment and forest resource management, including research, international accords, sector development for investment, and coordination for the implementation of Climate Resilient Green Economy. The Authority also prepares status reports on environment and forest related topics.

The Ethiopian Biotechnology and Emerging Technologies Institute is accountable to Ministry of Innovation and Technology. The Institute is working to create a system to coordinate and enable research on bio-technology and emerging technologies, which currently are dispersed in various sectors, to better contribute to the country's development objectives.

The Disaster Risk Management Commission (DRMC) is overseen by the Office of the Prime Minister and the commission has two objectives: conducting appropriate activities for the comprehensive implementation and realization of the objectives of the National Disaster Risk Management Policy and Strategy; and coordinating, monitoring, and providing appropriate support with respect to activities carried out by the lead sector institution.

Several relevant intergovernmental organizations are based in Addis Ababa, including the African Union (AU) Secretariat and its agencies and the United Nations Economic Commission for Africa (ECA). Ethiopia itself is bordered by six countries, and efforts to strengthen border post operations are being undertaken, including

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S

STRENGTHS

Endorsed intersectoral collaboration MOU among the relevant sectors

National One Health Steering Committee (NOHSC) is formally established with clear terms of reference (ToR)

Disease-specific Technical Working Groups (e.g. Rabies, Brucellosis, Anthrax, EPT, AMR) established and are active

National One Health strategies in place

One Health Taskforces are established at Regional level

IHR-PVS National Bridging Workshop conducted

Reprioritization of zoonotic diseases for inter-sectoral collaboration has been conducted

Joint outbreak investigation and responses is carried out

Coverage of veterinary services has increased

Existence of local capacity for production of animal vaccines and veterinary drugs

W

WEAKNESSES

Insufficient and inequitable government funding for One Health results in Ministries having different capacities

Large reliance on donor funding and external support for One Health activities

Poor data and information sharing among sectors

Poor implementation of multi-sectoral preventive & control strategies

One Health not yet institutionalized

Inability to maintain educational and professional standards and quality with rapid increase in veterinary schools; No statutory body to regulate profession

Insufficient budgetary allocation for veterinary services

Weak regulatory system

Weak linkage between field and laboratory

Weak private veterinary service

Weak animal disease surveillance

Lack of emergency fund

Weak cross border collaboration on Transboundary Diseases

Weak linkage between animal health research and Veterinary service

O

OPPORTUNITIES

Favorable government policies and good political commitment on human and animal health and the environment

Leadership and commitment from the higher government officials is strong

CSOs and professional societies that can contribute to One Health

Multi-year immunization plans for people could be leveraged (veterinary vaccines)

Various universities provide pre-service and in-service trainings on One Health

One Health is considered as one of the pillars during organizational restructuring

Number of veterinary institutions

Availability of national and regional veterinary laboratories

T

THREATS

Competing priorities, such as drought and health emergencies

Increasing trend of market inflation

Lack of clear legislation on public-private partnership pertinent to One Health

Institutional and organizational silos

Limited employment opportunities to meet supply of veterinary graduates; Few private sector veterinarians

Livestock movement poorly controlled

Natural and human made disasters

along Moyale and Galafi. Ethiopia has long utilized Djibouti's main port, reinforcing the importance of transboundary collaboration.

One Health Coordination

Created in 2016, the National One Health Steering Committee (NOHSC) consists of four Ministries: Ministry of Health (MoH), Ministry of Livestock and Fisheries (MoLF), Ministry of Culture and Tourism (MoCT) through the Ethiopian Wildlife Conservation Authority (EWCA), and the Ministry of Environment, Forest and Climate Change (MoEFCC). A key goal of the NOHSC is strengthening infectious disease prevention,

detection and response, facilitated by long-term collaboration. Leadership of the NOHSC alternates between the MOH, MOA and EWCA, promoting parity. A One Health Memorandum of Understanding (MoU) and One Health Strategic Plan was launched by the Government of Ethiopia in 2018. The MoU formalizes a commitment to collaboration on aspects such as surveillance, data sharing, preparedness and communication plans, and outbreak investigation and response. However, the varying resources and capacity of participating Ministries makes equal sharing of responsibilities difficult. Staff workload and turnover is a challenge, particularly for technical experts participating in multiple Technical Working Groups.

The NOHSC is financially supported by USAID and the GHSA; many partners provide technical support. The National One Health Strategy (2018-2022) has been

Table.
Summary of pillars and objectives under the National One Health Strategic Plan

PILLARS	OBJECTIVES
Pillar 1: Coordination and Collaboration	Ensure effective and functional One Health coordination mechanism at all levels (including via regional TWGs); Mainstream One Health activities in all relevant government sectors; Develop and implement monitoring and evaluation system for OH at national and sub-national levels
Pillar 2: Preparedness and Response	Establish and strengthen multi-sectoral and multidisciplinary capacities at all levels for timely detection, and rapid response to emerging and re-emerging priority threats at the human-animal-environment interface; Develop, implement, and promote multi-sectoral prevention and control strategies and response plans for priority emerging and re-emerging zoonotic diseases using a One Health approach
Pillar 3: Surveillance and Reporting	Establish and strengthen integrated multi-sectoral surveillance systems; Operationalize regular sharing and use of surveillance data and information across sectors
Pillar 4: Policy, Advocacy and Communication	Improve enabling policy environment across all collaborating sectors for One Health implementation and secure high-level buy-in and support across all sectors; Improve knowledge, attitude, behavior and practice of community on health threats or risks at the human, animal, and environment interface
Pillar 5: Research and Capacity Building	Conduct joint research projects on prioritized zoonotic diseases and other health threats at the animal-human-environment interface; Improve policy on disease prevention, detection and response in line with research findings; Improve human resource and infrastructure capacity for health research

developed that commits the country to develop One Health coordination mechanisms at all levels, working through five pillars (see Table with its specific objectives). The structure includes: the National One Health Steering Committee (NOHSC), disease specific Technical Working Groups (TWGs) created by NOHSC, professional associations, and Risk Communication TWGs. In addition, the Antimicrobial Resistance (AMR) Prevention and Containment Advisory Committee, which oversees development of the country's AMR strategy, includes multi-sectoral representation. While national strategies are in place, sufficient government funding has not been mobilized for implementation. Implementation activities rely on external support.

AHRI also has a One Health Unit, which performs research on zoonotic diseases (e.g., brucellosis, Middle East Respiratory Syndrome-Coronavirus, Q fever), human-animal health surveillance and control strategies, and the role of wildlife and the environment in public health. The unit collaborates with national and international research institutions and universities as well as domestic and wild animal health and public health entities.

Training Pipelines

New veterinary programs and initiatives are being established in new universities, but they lack appropriate curricula to prepare for certifying and operating as an official veterinarian. Over recent years, the number of veterinary schools in Ethiopia has grown from 1 to 11, and institutions are operating with significant variations. The DVM curriculum and curricula of other degrees (e.g., B.Sc. in AH, VLT, and B.Sc. in veterinary pharmacy) are not nationally harmonized nor reviewed periodically. To ensure coverage across the country, the government has set a general aim of one animal health clinic or post to support every three peasant associations (known as kebeles). However, with the rising number of veterinary graduates, there is a lack of suitable career structure and salary scales, resulting in high levels of unemployment. The government, instead of providing incentives to the private sector, has been expanding the number of public clinics, which

does not necessarily increase the provision of clinical service delivery in these areas. With such rapid growth comes a risk relating to maintaining educational and professional standards in teaching and in professional practice and addressing new and growing challenges in the sector such as trade, diversification and intensification of production systems.

Ethiopia does not have an autonomous statutory body to regulate the veterinary profession, license and register veterinary surgeons and veterinary practitioners, and regulate professional education and professional conduct. There are shortages of experienced academic staff, resources, and facilities (namely laboratories, clinics, farms, abattoirs) particularly in newly opened veterinary colleges and schools, as well as overall limited workforce with specific training in field such as advanced laboratory technologies, veterinary pharmacists, meat inspectors, veterinary biomedical engineers, animal health economists, poultry health specialists, wildlife veterinarians, and fishery health experts. There is no continuous professional development.

There are few private veterinary service providers outside of veterinary drug importers and distributors, few private veterinary pharmacies and very few community animal health workers (CAHWs), who are often supported by NGOs. A challenge is retaining veterinary field personnel at the woreda (district), zonal and regional bureaus, especially in rural pastoral areas.

Ethiopia's Field Epidemiology Training Program (FETP)-Frontline began in 2016. So far, over 800 students have graduated or are in training, serving mainly at the district level. The EFETP was first established in 2009 at Addis Ababa University, with financial and technical support from the U.S. CDC. Basic and Advanced EFETPs are available, including a Master of Public Health focused on infectious disease field work and other fields of sub-specializations. These public health courses involve veterinarians and various human health professions. In 2015 Ethiopia's Advanced FETP expanded to seven more universities to cover more of the country, though veterinary training in these

programs has been low. Through these 8 universities and 41 field bases, advanced training courses on public health are conducted, overseen by the supervision of MoH (EPHI) and the Government of Ethiopia, which supports the expansion of the program toward the target of one epidemiologist per 250,000 people. Attrition of FETP graduates in the public sector is reportedly high, but FETP participants often hold key positions in the Ethiopian health system, particularly

the PHEM. All regional health bureaus and zonal health bureaus have EFETP graduates.

The Frontline In-Service Applied Veterinary Epidemiology Training (ISAVET) program launched in Ethiopia in 2020, a partnership between FAO, the Federal Ministry of Agriculture, and the College of Veterinary Medicine and Agriculture with support from USAID. A second cohort began in June 2022.

The Armauer Hansen Research Institute (AHRI) trains postgraduate students (MSc and some PhD) in research activities (immunology and molecular biology, epidemiological and translational research), including on clinical trials with international collaborators.

Box.
**Training Initiatives with International
Collaboration (examples)**

Jigjiga One Health Initiative (JOHI): run by Jigjiga University, the Armauer Hansen Research Institute (AHRI—MOH), and Swiss Tropical and Public Health Institute in Basel with funding from the Swiss Agency for Development and Cooperation, it focuses on capacity building at the University toward a center of excellence for One Health studies and integrated health systems serving pastoral communities.

AFROHUN: Ethiopia is part of the Africa One Health University Network (AFROHUN). There are Ethiopian Student One Health Innovation Clubs at Mekelle and Jimma Universities.

Human Resources for Health 2030: In 2019, NOHSC established Regional One Health taskforces (ROHTF), which have been established in several states, with support from the USAID-funded Human Resources for Health 2030 project and facilitated by NGO partners of the NOHSC. The ROHTF membership is drawn from different sectors: health, environment, animal health, education, academia, and private practitioners.

WOAH Veterinary Education Twinning Program: The University of Gondar College of Veterinary Medicine and Animal Sciences and The Ohio State University College of Veterinary Medicine have partnered to set the standard for professional veterinary education, increasing veterinary competence in Ethiopia in a One Health spirit.

Strengthening Ethiopian Veterinary Services projects: several projects have been conducted over the past decade under Ministry of Agriculture, including with ILRI and Wageningen University. The Health of Ethiopian Animals for Rural Development, or HEARD project, partners with ILRI to focus on both public and private veterinary services, including with the Ethiopian Veterinary Association. It has a food safety component.

VETLAB Network (AIEA/FAO): VETLAB seeks to reinforce laboratories facilities (including through certification), training of technicians and improved diagnostic capacity. The network is funded through the South African “African Renaissance and International Co-Operation Fund” and the IAEA’s Peaceful Uses Initiative (supported by USA and Japan).

DISEASE MANAGEMENT

Surveillance and Reporting

The ministries and directorates mainly responsible for the surveillance of zoonotic diseases are the Ministry of Health (MOH), the Ministry of Agriculture (MOA) and the Ethiopian Wildlife Conservation Authority (EWCA). Under the MOH, the Ethiopian Public Health Institute (EPHI) oversees outbreak investigations in humans, reportable disease surveillance, and human laboratory diagnostics. EPHI also conducts diagnostics for rabies in animals. Under the MOA, the Veterinary Public Health Directorate, the Disease Prevention and Control Directorate, and the Epidemiology Directorate are mandated with surveillance and response activities in livestock. These entities collaborate with the Animal Health Institute (AHI), which performs most animal diagnostic functions. The EWCA has authority for the conservation and management of wildlife and wildlife habitats and works on wildlife health aspects with MOA, EPHI and AHI.

The Ethiopian Public Health Institute (EPHI), in collaboration with partners, established a National Data Management Center (NDMC) to serve as a central hub for surveillance information. The NDMC captures data from research institutions and health facilities, which is shared weekly through bulletins.

IDSR has been implemented in Ethiopia since 2000 and is a pillar in the Public Health Emergency Management (PHEM) system. PHEM oversees regional health bureaus, zonal health departments, and district health offices. It tracks 22 priority diseases.

The MoH has tasked EPHI/PHEM as focal point for IHR 2005 in the country. Rabies, Anthrax, brucellosis, leptospirosis, and echinococcosis were agreed upon during joint public health/animal health discussions held in September 2015. In 2019, a One Health Zoonotic Disease Prioritization (OPHZDP) exercise reprioritized 5 zoonotic diseases of greatest national concern for multisectoral, One Health collaboration in Ethiopia: Anthrax, Rabies, Brucellosis, Rift Valley Fever and Zoonotic Avian Influenza. In addition, eight NTDs

were identified as priorities and a national strategic control and elimination plan is in place. Millions of Ethiopians are at risk of these endemic diseases (trachoma, onchocerciasis, lymphatic filariasis, soil-transmitted helminths, schistosomiasis, leishmaniasis, dracunculiasis and podoconiosis).

Surveillance was examined in the 2016 JEE mission, and in 2018 the FAO conducted an animal health surveillance system evaluation with the Ministry of Agriculture and Livestock Resources using FAO's Surveillance Evaluation Tool (SET). From a One Health lens, human and animal health surveillance systems are not interoperable and surveillance information is not shared across sector. Rather, communication is often person and irregular. Only a few zoonotic diseases (HPAI, RVF, rabies and anthrax) are reported in both systems. The livestock health functions under the Ministry of Livestock utilize two data reporting systems for transmitting animal disease information to the central government, including disease type, location, and numbers of animals affected. Disease Outbreak and Vaccination Reporting (DOVAR) is for monthly reporting. Animal Disease Notification and Investigation System (ADNIS) is for immediate event-based reporting.

ADNIS and DOVAR do not include information on the number of humans affected by reportable diseases such as anthrax. The lack of consistency in routine information collected makes it challenging for the Ministry to precisely estimate the incidence and prevalence of zoonotic diseases.

At a national level, disease outbreak reporting rates remain below the minimum standards of WOA. Under-reporting is particularly high in pastoral and agro-pastoral settings where livestock disease reporting is constrained by lack of trained personnel, irregular reporting, poor recording and documentation, and poor infrastructure (e.g., for detection of bovine brucellosis). Local authorities involved in integrated disease surveillance and response (IDSR) functions gather and report information on some zoonoses in humans. However, financial and human constraints can prevent local officers from duly reporting on all

zoonoses, which reduces the information base for the Ministry of Health. Even when data on the prevalence and incidence of zoonotic diseases are available, including both in animals and humans, there is no integrated information collection to estimate their impact on society (e.g. on livestock production and labor productivity).

Ethiopia uses multiple laboratory information management systems in human health hospitals and laboratories. National veterinary laboratories at central and district levels have adopted the “SILAB for Africa” (SILAB-FA), a free software system.

Access to Diagnostics and Vaccines

Diagnostics

The Animal Health Institute is a referral and reference veterinary laboratory. It has 9 labs at BSL-2, and one at BSL-3 for the diagnosis of zoonoses. By 2013, the Animal Health Institute (AHI) had made considerable progress in carrying out nation-wide and targeted surveillance for selected diseases, establishing and implementing a quality assurance program, training staff in the regional laboratories, and establishing a suite of WOAHA-recommended laboratory tests to support disease control and exports. So far, the AHI is accredited for eleven tests and 6 diseases.

Shortages in staffing, funding, and supplies, including kits and consumables, have hindered effectiveness of the 15 state veterinary laboratories over the years. Since 2011, support in veterinary disease laboratories and diagnostics has been brought through the “VETLAB network”, a multi-country project led by FAO, IAEA and the South African government. The National Animal Health and Disease Investigation Centre (NAHDIC) and the National Veterinary Institute (NVI) were identified as candidates for centers of excellence in transboundary animal diseases diagnostic in East Africa. Equipment, reagents and consumables, staff

trainings were provided in early and rapid diagnostic and control of transboundary animal diseases (e.g. FMD, RVF, ASF). As a result, the NVI and NAHDIC received ISO 17025 accreditation from the Ethiopian National Accreditation Office in 2014, including for RT-PCR techniques. Both laboratories have now become regional training hubs for VETLAB Network scientists and serve as a regional reference laboratory.

A clinical bacteriology and mycology laboratory has been established in Ethiopia’s national reference laboratory for AMR. In 2018, FAO, via ECTAD, facilitated and coordinated participation of five laboratory experts at a regional laboratory and field training on integrated surveillance and testing of AMR in bacteria from humans, animals, food and the environment. Ethiopia’s trainees represented human and animal health, agriculture, food and drug authorities and universities, supporting AMR laboratory capacity in multiple sectors and settings.

Vaccination

Since 2011 Ethiopia has had a Comprehensive Multi Year Plan through its National Expanded Programme on Immunization. Polio is a high priority, with a number of efforts under way, including a type 2 novel oral polio vaccine (Nopv2) campaign for children under five to halt the circulation of vaccine-derived poliovirus. There have been focused efforts on polio vaccination of pastoralist communities, with partners including Rotary International and the CORE Group. The National Veterinary Institute (NVI), within the Ministry of Finance/Public Enterprises Holding and Administration, is producing a wide range of vaccines (>20) against various livestock and poultry diseases for local use, and at times, for export. This is an important resource, though in some cases production does not reach high enough quantities to meet demand. Recently, the Institute has also started producing veterinary drugs.

In 2020, the International Committee of the Red Cross (ICRC) and the Ethiopian Red Cross Society, with the Somali Region Livestock Resource and Pastoral Development Bureau and the Oromia Region Pastoral

Table.
Reportable diseases, by system

ANIMAL DISEASES REPORTED BY LOCAL
AUTHORITIES TO THE DOVAR SYSTEM

African horse sickness
 African swine fever
 Anaplasmosis
 Anthrax
 Babesiosis
 Black quarter
 Brucellosis
 Camel pox
 Canine distemper
 Contagious bovine pleuropneumonia
 Contagious ecthyma
 Contagious caprine pleuropneumonia
 Dourine
 Echinococcosis
 Equine herpes virus
 Ehrlichiosis (Cowdriosis)
 Foot and mouth disease
 Fowl cholera
 Fowl typhoid
 Gumboro (Avibirnavirus)
 Haemosepticemia
 Highly pathogenic avian influenza
 Infection coryza
 Lumpy skin disease
 Lymphangitis
 Maedi visna
 Malignant cattle fever
 Marek's disease
 Newcastle disease
 Pest des petits ruminants
 Pullorum disease
 Rabies
 Rift Valley fever
 Sheep and goat pox
 Dermatophilosis (Streptothricosis)
 Trypanosomiasis
 Tuberculosis

HUMAN DISEASES REPORTABLE
TO EPHI

Immediately reportable

Acute flaccid paralysis/Polio
 Anthrax
 Avian human influenza
 Cholera
 Dracunculiasis/Guinea worm
 Measles
 Pandemic influenza A
 Rabies
 Smallpox
 Severe Acute Respiratory Syndrome
 Viral hemorrhagic fevers
 Yellow fever

Weekly reportable diseases

Dysentery
 Malaria
 Meningococcal meningitis
 Relapsing fever
 Severe malnutrition
 Typhoid fever
 Typhus
 Maternal and Perinatal Death
 New HIV Infection/Viral Load

Area Development Commission, held a vaccination campaign in East Ethiopia. In this campaign, almost 500,000 animals were vaccinated, including over 400,000 animals against Anthrax as well as herds of cattle against Black Leg and Bovine Pasteurellosis and sheep and goats against ovine Pasteurellosis. From the private sector, Zoetis has a partnership with local distribution agents, aligned to the African Livestock Productivity and Health Advancement (A.L.P.H.A.) initiative supported together with the Bill and Melinda Gates Foundation.

PREVENTION AND CONTROL MEASURES

Anthrax, rabies, brucellosis, Rift Valley fever and zoonotic Avian Influenza are the top 5 zoonotic diseases of greatest national concern. As such, the country has elaborated disease Prevention and Control Plans for Rabies and Anthrax, Disease Preparedness and Response Plans for HPAI and RVF, a guideline for Anthrax Surveillance and Outbreak Management, and a Brucellosis prevention and control guideline. The country, through the National One Health Steering Committee, has undertaken a Joint Risk Assessment process with FAO, beginning with a train-the-trainer exercise in 2019 and a JRA roll out in 2021, focusing on import risk analysis and identifying management options and communication needs. To promote awareness and risk reduction in the general public, Ethiopia has formed a One Health Zoonotic Diseases Risk Communication Strategy.

Rabies in Ethiopia remains a public health problem both in domestic animals and humans. Human rabies deaths and rabies exposure cases each year are estimated at 2,700 and ~70,000, respectively. Canine vaccination coverage is reported to be very low, at 0.50% according to the Global Alliance for Rabies Control. The Rabies Technical Working Group, established under NOHSC, has developed the National Rabies Control

and Elimination strategy, which is being implemented. The implementation plan was adopted jointly by the Ministry of Health, Ministry of Livestock and Fisheries, Ministry of Culture and Tourism, Urban Agriculture Bureaus and Ministry of Health, aiming to advance from an endemic state to a disease-free status. At present, mass dog vaccination is being conducted along with health education activities in different regions.

Two regional veterinary labs have initiated rabies diagnosis through technical and financial support from the U.S. CDC and EPHI. NVI has also developed the capacity to manufacture 400,000 doses of vaccine each year for animal use; this year, NVI produced 370,000 doses. For human use, EPHI is producing about 33,000 doses of nerve tissue-based vaccine annually.

Ethiopia developed the National Action Plan for Antimicrobial Resistance in 2009, with update in 2015: the National Strategic Framework for Prevention and Containment of Antimicrobial Resistance. A multisectoral advisory committee (including MoH, MoA and others) revised the plan to align with the Global Action Plan on Antimicrobial Resistance. However, as reported by the Joint External Evaluation, there have been challenges in implementation, among them suboptimal stewardship in human and animal health sectors and low overall awareness of the importance of preventing and controlling AMR, particularly among the animal health and production sectors. Another issue is limited coordination between sectors, including AMR-related information sharing.

Both the animal and public health sectors have laboratory capacity for antimicrobial resistance screening. There is ongoing culture and sensitivity testing for more than eight human pathogens throughout the country based on WHO recommendations. The Animal Health Institute tests some clinical animal samples, especially for resistance to Streptococcus and Staphylococcus in milk samples and for Salmonella in poultry.



- High faunal and floral diversity and many protected and conserved areas
- Grazing land is declining, increasing reliance on commercial feed markets and threatening livelihoods of small-scale farmers
- Conflict is disrupting the health of people and of livestock
- Highly prone to disasters, particularly to drought, floods and landslides, that drive food insecurity
- Periodic desert locust infestations affect agricultural production
- Small reserves of precious minerals and natural gas; extensive hydropower potential
- Large-scale deforestation is linked to rapid population growth and reliance on rain-fed agriculture
- Changes in rainfall patterns due to climate change (less predictable, with late onset, early cessation and changing distribution)
- Climate-sensitive vector-borne diseases threaten human and animal health

Legal requirements for prescribing antimicrobials in the animal health sector are inadequate. Sentinel surveillance in animals is limited in the animal health sector, and there is little antimicrobial susceptibility testing in animals, relying mainly on use of broad-spectrum antimicrobials. The Ministry of Health has developed National Infection Prevention and Control Guidelines. A training of trainers' workshop was held to introduce the IPC Guidelines in health facilities. Ethiopia also expanded its AMR surveillance network in 2019, with 9 laboratories that now have capacity for bacterial testing and AMR reporting (see case study).

ETHICS

As of June 2022 there were no animal welfare regulation or constitutions that protect animals from suffering. Currently, an Animal Health and Welfare proclamation is being drafted. An animal research ethics committee exists in a few academic and research institutes in the country.

ETHIOPIA CASE STUDY:

Antimicrobial Resistance (AMR)

CURRENT STATUS

Antimicrobial Resistance (AMR) is recognized as a global threat to humans, animals, and the environment and a serious and growing challenge in Ethiopia, requiring a One Health approach. The Government of Ethiopia considers AMR as a top priority public health agenda and is working to promote, facilitate, finance and monitor the effective implementation of National AMR Prevention and containment strategies.

The detection of AMR pathogens is frequently reported in human and animal populations, food sources, and the environment. Antimicrobial misuse in multiple sectors and improper waste management are among the major risks for the emergence and spread of AMR.

HIGH-LEVEL STRATEGIES

A five-year Prevention and Containment Strategic Plan (2021-2025) has been developed under the One Health approach involving key stakeholders in government and other sectors. The implementation of this strategic plan is being coordinated and monitored by the National Antimicrobial Resistance Advisory Committee (NAMRAC), whose membership includes the human health, animal health, food, and environmental sectors.

SURVEILLANCE

The surveillance plan for public health, including through the Ethiopian Public Health Institute, is served by the National Reference laboratory. So far, 16 sentinel surveillance sites are established across four regions and one city administration; plans exist for the expansion of the network to additional sites across the country. An integrated AMR Surveillance plan for animal health, Plant, Food safety and Environment sectors was developed through the National Animal Health

Diagnostic and Investigation Center (NAHDIC) and being implemented. For detection and characterization of AMR pathogens, both phenotypic and molecular methods are employed.

PREVENTION AND CONTROL

Ethiopia is striving to prevent and contain AMR through a comprehensive One Health strategy. The strategies currently deployed to fight AMR include implementation of effective stewardship practices, enhancing infection prevention and control measures, and generating knowledge and evidence on antimicrobial use and resistance.

REGIONAL CONSIDERATIONS

AMR presents cross-border implications, particularly in the Horn of Africa where resources are scarce. This is particularly relevant given low health coverage in these countries, resulting in communities needing to look to alternatives sources that may favor the illicit trade of medicines. In many cases, medicine from such sources have substandard qualities. Substandard medicines often contain a lower amount of the correct active ingredient, which can fail to kill the targeted pathogens and may contribute to the development and spread of AMR in the region. Despite the free movement and trade across the border in the Horn of Africa, there is

not any specific collaboration and coordination to control AMR among Horn of Africa countries.

IMPLEMENTATION GAPS

The current barriers to implement AMR prevention and containment strategy include:

- Limited awareness of AMR implications in human and animal health among the general public, policy makers and animal and public health practitioners
- Weak healthcare systems in which many people lack access to services, leading to antimicrobial misuse
- Weak surveillance systems due to essential laboratory reagents and consumables
- Inadequate resource allocation for laboratory infrastructure, diagnostic tools and trained personnel
- Poor enforcement of regulation at National and Regional level
- Inadequate research and development of new antimicrobials and diagnostics

KEY RECOMMENDATIONS

- The following are recommended to address the above listed implementation barriers:
- Allocate adequate resources for the implementation of AMR prevention and containment strategy plan
- Develop the necessary legal frameworks to enforce the AMR prevention activities
- Establish regional and bilateral collaboration to enhance the prevention and Control activities of AMR



Kenya

Completed Assessments and Plans

JEE	PVS Evaluation	PVS Evaluation Follow-Up	PVS Gap Analysis	PVS Legislation	IHR-PVS Bridging Workshop	NAPHS	OHZDP	National AMR Action Plan	NBSAP
2017	2007	2011	2011	2015	2021	2018	2015	2017	-

Indicator

Country Region Average Continent Average

Coordination and Financing

Multi-sector and One Health collaboration/coordination for AMR (1-5)	3.00	2.25	2.44
Collaborative effort on activities to address zoonoses (0-100)	60.00	54.12	54.23
Current health expenditure per capita (USD)	83.41	130.86	132.25
CFE disbursements (USD)	623,000.00	1,742,137.45	4,903,032.44

Workforce

Veterinarians (total)	6,773.00	3,096.00	3,512.00
Veterinarians (per 1,000 people)	0.13	0.16	0.17
Public animal health professionals (total)	535.00	212.00	461.00
Public animal health professionals (per 1,000 people)	0.01	0.01	0.02
Medical doctors (total)	8,042.00	3,310.00	8,574.00
Medical doctors (per 1,000 people)	0.16	0.42	0.41
Up-to-date multisectoral workforce strategy (1-5)	2.00	2.33	2.19
Progress with strengthening veterinary services (1-5)	4.00	2.62	2.80

Demographic Factors

Population (total)	52,573,967.00	24,025,701.94	24,185,802.76
Population growth (% , 2010-2019)	25.10	23.76	23.73
GNI per capita (USD)	1,830.00	2,517.78	2,525.37

Environmental and Sanitation Factors

Land area (sq km)	569,140.00	378,644.97	548,414.71
Arable land (% land area)	10.19	18.53	14.14
Forest area (% land area)	6.34	24.89	27.57
Terrestrial protected areas (% land area)	12.36	17.04	16.27
Average primary forest loss (ha)	2,634.54	6,271.69	20,326.14
Access to basic drinking water – rural (%)	49.60	49.58	55.48
Access to basic drinking water – national (%)	58.90	63.02	69.76
Access to basic hygiene – national (%)	24.70	18.18	26.71
Access to basic sanitation – national (%)	29.10	35.66	40.71

Animal Factors

Average livestock stocks (LSUs)	17,800,415.48	6,601,349.50	5,551,123.37
Average livestock exports (LSUs)	23,393.45	44,401.60	33,314.93
Average livestock imports (LSUs)	10,270.30	12,869.29	31,044.50
Mammal species (number)	476.00	240.61	241.65

STATUS OF ONE HEALTH AND VETERINARY SYSTEMS

Kenya has a devolved system of governance, in which there are two distinct and inter-dependent levels of government at the national and county level. Since 2010, the implementation of government services have been largely devolved to the counties and sub-counties. Veterinary and human health services, including surveillance and laboratory diagnosis for zoonoses, are devolved to 47 counties and 290 sub-counties. County governments oversee disease control activities, livestock sale yards and abattoirs, animal welfare and control, and veterinary services. Counties have their own health departments which manage county health facilities and pharmacies, promote primary health care, oversee license and control food sales to the public, and manage refuse and solid waste disposal.

The Ministry of Health's (MoH) Department of Preventive and Promotive Health oversees the Division of Disease Surveillance and Epidemic Response, Division of National Public Health Laboratory, and Division of Environmental Health. The Ministry of Health also oversees the National Emergency Operations Center, however, efforts are underway to establish emergency operations centers at the county level. The National Disaster Operation Centre, within the Ministry of Interior and Coordination of National Government coordinates national responses to disasters, including those with impacts on public health. The Zoonoses Disease Unit (ZDU) is also administratively under the MoH, with technical oversight from both MoH and the Ministry of Agriculture, Livestock and Fisheries (MoALFD).

Kenya Medical Research Institute (KEMRI) operates as a quasi-government agency under the Ministry of Health. It is the national focal point for health research and advises on matters related to healthcare, healthcare delivery, and surveillance and response capacity during major disease outbreaks. It has 12 research centers, including a Centre for Infectious and Parasitic Disease Control Research and Centre for Virus

Research. Some of KEMRI's mandate will soon fall under the new National Public Health Institute.

The Veterinary Epidemiology and Economic Unit (VEEU) within the MoALFD is mainly involved in managing surveillance data, providing early warning notifications to the Directors of Veterinary Services (DVS) and the county governments, training and supporting county surveillance teams, developing county surveillance strategies and contingency plans, launching surveillance tools and systems at the county-level, and advising the DVS on matters of national disease control. VEEU is also involved in response to outbreaks when called upon by the respective counties who may lack the logistical and technical support that the national government provides in lieu of national interests. This normally takes the form of motor vehicles (since some counties are under-resourced), specimen handling, submission and testing to the Veterinary Investigation Laboratories or Central Veterinary Laboratory, ring vaccinations, risk communication and reporting among others. Sometimes the VEEU helps with drafting of the request from the counties to the DVS, according to their assessment of the needs from the affected county. On several occasions, VEEU may step in due to national interests even without requests from the counties, especially in cases of notifiable transboundary disease outbreaks with zoonotic and trade implications. VEEU also serves to support partners that would like to engage the veterinary department in research, such as conducting economic impact studies of partner-driven interventions.

County Directors of Veterinary Services (CDVS) manage veterinary services across the county, which are implemented by Sub-County Veterinary Officers. County Directors of Health oversee County Disease Surveillance Coordinators who are responsible for planning and supervising disease surveillance activities and sub-county public health officers who implement disease surveillance and control activities. Since counties experience different disease burdens, they have different priority diseases.

SWOT ANALYSIS | KENYA

S

STRENGTHS

Existing One Health framework and strategies (e.g. National One Health Action Plan, Strategic plan for the prevention and control of zoonotic diseases, Rabies Elimination)

National One Health secretariat in the form of the Zoonotic Disease Unit

Ongoing development of One Health surveillance platforms

List of priority diseases for One Health surveillance is available

Involvement of the wildlife subsector in One Health initiatives

Presence of regional initiatives

Joint responses for zoonotic disease outbreaks (e.g., RVF, Rabies, Leishmaniasis)

One Health approach incorporated in training curricular and sectoral policies for both human and animal health

Availability of training institutions and programs

W

WEAKNESSES

Devolution system of governance leading to uncoordinated priorities among counties

Understaffing at the ZDU and in the counties

Loss of traction by the ZTWG leading to a gap in oversight at the ZDU

Environment sector is underrepresented (often unclear who to engage with the abundance of related departments)

Lack of line budgetary support for One Health activities from the exchequer through the respective line ministries

Limited sharing of resources by line-ministries in-country (e.g. laboratories, vehicles and equipment)

Misalignment of donor funding with county/national government priorities

Inadequate information sharing platforms between counties and national government

Non-structured data-sharing platform for One Health surveillance data

Limited data analysis capabilities by One Health practitioners

O

OPPORTUNITIES

Relative political stability compared to other countries in the region

Donor interest in One Health has led to piloting of approach in selected counties

Engagement and integration of AMR surveillance platform with One Health secretariat

Opportunity for direct budgetary support for One Health activities through county One Health Coordination Units by the devolved county governments, where funding has not been prioritized at national-level

Strong research communities who can share data with government to inform One Health policy and support implementation

National Public Health Institute will enhance surveillance and improve One Health advocacy and workforce development

Presence of existing national surveillance system that OH surveillance can ride on

T

THREATS

Inadequate SOPs and document archiving at the ZDU threatens institutional memory

Five-year cyclic disruptions in governance; Advancing pending One Health issues is not prioritized, where impact on election outcomes is not clear

Public health emergencies may divert resources away from One Health institutionalization and activities

Regional One Health workforce shortage may lead to mobility of competent One Health champions away from country to neighboring regions and international agencies

Donor dependency is a challenge to sustainability of One Health initiatives

High turnover of staff seconded to the ZDU

The Kenya Wildlife Service (KWS) is a parastatal under the Ministry of Environment, Water and Natural Resources. It includes parks and reserves, species conservation and management, captive wildlife management and veterinary care, capture, and forensic and molecular lab services. It generates and remits revenue to the exchequer. It operates on an annual budget with funds from the national treasury. This includes funding for its veterinary unit, which is tasked with undertaking wildlife disease surveillance and reporting findings to the DVS (and therefore the WOAH Delegate for Kenya).

The KWS veterinary services department has a strong network of local, regional and international partners working in areas of animal, human and environmental health. The partners include the Director of Veterinary Services, Director of Medical Services in the Ministry of Health, Kenya Agricultural Research Institute, the International Livestock Research Institute, International Centre for Insect Physiology and Ecology, the National Museums of Kenya, Institute of Primate Research, Universities, the African Union- Intra-bureau on Animal Resources, Lewa Wildlife Conservancy, Animal Rights Reserved, and David Sheldrick Wildlife Trust among others. KWS research department has been delinked from KWS to form a new research entity separate from the parent agency. The Wildlife Research and Training Institute (WRTI) is being established with its own national funding and premises in Naivasha.

Kenya's Health budget is highly dependent on external funding. Kenya's One Health and veterinary systems are no exception. Since inception, financing of Kenya's One Health activities has been donor driven, chiefly by the U.S. CDC. Acquiring sufficient government funding to implement the National One Health Strategy is a challenge. The Zoonotic Disease Unit (ZDU), Disease surveillance, Field Epidemiology and Laboratory Training Program, and much of KEMRI's activities are reliant on external funding. ZDU prepares and remits budgets to the Ministry of Health, but it only receives minimal financial allocation.

Actors and partner organizations that provide funding to human and animal health sectors include WHO, U.S.

CDC, PEPFAR, BMZ, USAID, NIH, UNICEF, BMGF, Wellcome Trust, Global Fund, FAO, WOAH, the Fleming Fund and others. The Ministry of Health is developing a Public Private Partnership Strategy and toolkit as an innovative financing mechanism to complement the Government's health financing efforts. This is aimed to help support the attainment of Kenya's Universal Health Coverage.

Under the devolved governance structure, counties are tasked with responding and controlling diseases from their respective budgets and technical resources, however, most counties are resource constrained. Consequently, counties often call on VEEU for logistical, technical, and resource support in response to outbreaks. In the future, counties may have an opportunity to allocate the prerequisite resources for all One Health activities through the County One Health Unit (COHU); five counties have already expressed their interest and are advancing this potential model. In many counties, this could double as the committee for all other One Health issues (e.g. the County Antimicrobial Steering Inter-Agency Committee, Rabies Action Groups). However, devolution disables negotiations and economies of scale associated with bulk-purchase of biologics from outside the country.

One Health Coordination

At the national level, the Zoonotic Disease Unit (ZDU) established in 2011 is responsible for One Health coordination and implementation. It is primarily composed of staff from the Veterinary Epidemiology and Economics Unit (VEEU) within the Ministry of Agriculture, Livestock and Fisheries (MALF). The 2021-2025 National One Health Strategy was launched in February 2022. The Strategy aims to strengthen One Health implementation at national and county levels, with an emphasis on operating in a devolved environment, and promoting applied research. ZDU with the help of FAO and the Federal Government of Germany developed multi-sectoral contingency plans and national disease control strategies for Anthrax and Brucellosis. The ZDU has also released multi-sectoral strategies for Rabies and Antimicrobial Resistance.

ZDU is supervised by the Zoonotic Technical Working Group (ZTWG). The leadership of the ZTWG rotates between the Ministry of Health and Ministry of Agriculture, Livestock, and Fisheries. Over the past five years, ZTWG has been less active in overseeing ZDU. Leadership changes at both the ZDU and ZTWG, understaffing at the ZDU, and reliance on external donor support has resulted in gaps in supervision, budget, traction, and buy-in. Attempts to engage the Ministry of Environment in the ZDU are in progress. The environmental actors are continuously being sensitized on their role in OH and these efforts are yielding fruits. The inclusion of UNEP at the global level to the tripartite (WHO-FAO-WOAH) has synergized local initiatives.

The ZTWG, for instance, previously held quarterly review meetings as well as meetings whenever there was an outbreak of a suspected zoonotic disease. However, such quarterly meetings have not taken place in the last couple of years. This is in part due to leadership changes in the Ministry of Health and Ministry of Livestock and Fisheries whereby current leadership has provided more limited oversight, especially given their competing priorities, and less enthusiasm for convening stakeholders together. This has led to inadequate oversight at the ZDU secretariat, sub-optimal review, low budgetary support, and loss of traction. In the absence of a quarterly ZTWG meeting, there is a gap in supervision, oversight, feedback, stakeholder buy-in and support for One Health at the national and county levels. This is exacerbated by understaffing at the secretariat. The offices are frequently closed whenever a One Health field activity or meeting occurs outside the office since all the staff would be engaged in the activity outside the office.

At the county level, disease prevention and control priorities are uncoordinated and often under resourced. Outbreak response is often fragmented and uncoordinated between neighboring counties and

counties rely on the national VEEU for technical and resource support. Creating County One Health Coordination Units has been a goal since 2019. This is currently being implemented by the Global Implementation Solutions (GIS) through a grant from the U.S. CDC under the Global Health Security Agenda (GHSAs). The initial five counties were sensitized and SOPs and Modules had been developed awaiting implementation. To date, no county has fully implemented a County One Health Unit, due to stalls in external donor funding that have delayed implementation.

Since their inception, One Health activities in Kenya have been donor driven. Government funding is not sufficient to implement the activities outlined in the National One Health Strategy. This has resulted in a patchwork of One Health research and implementation that is not necessarily aligned with Kenya's strategic priorities. The government, with the support of FAO, undertook a Policy Mapping and Cost Benefit Analysis of One Health interventions in Kenya. This was presented to One Health stakeholders at a meeting convened by the ZDU in February 2022. There have been no specific follow-ups from this meeting. It has been suggested that officials from the national budget office of the Ministry of Finance be incorporated into One Health technical committees.

Currently, discussions are underway with regards to re-locating the One Health office to the management of a higher level of government, such as the Office of the President. FAO has been supporting these proposals. This is an attempt to increase the priority of One Health within government and to harness more resources to support implementation.

Training Pipeline

As of 2021, two universities train veterinarians. Several other colleges (e.g. the College of Agriculture and Veterinary Sciences at the University of Nairobi, the Meat Training Institute, and three Animal Health Technical Institutes) offer various diplomas and certificates in related areas of study. The training of



- Forest, wetland, savannah, marine, arid and semi-arid protected ecosystems
- Outdated biodiversity assessments
- Mount Kenya's glaciers are at risk of melting, threatening a major source of water, hydropower, and agriculture
- Agriculture is key to Kenya's economy, is large and complex, with a multitude of public, parastatal, non-governmental and private sectors
- Livestock keeping serves as the main livelihood for nomadic populations
- High population growth in urban areas is expanding informal settlements
- High dependence on rain-fed farming systems
- Wildlife-based tourism is the second largest foreign exchange earner for the country following agriculture
- Human-wildlife-livestock interactions have increased as a result of expanding populations, wild meat consumption, poaching, and drought
- Wildlife routinely migrate out of protected areas in search of pasture and water

environmental health officers in Kenya is yet to embrace a One Health approach. Jaramogi Oginga Odinga University of Science and Technology is the only institution in that has made attempts incorporating the One Health approach into the environmental health curriculum.

In-service surveillance training programs are most often supported by external partners, which can affect their availability. For instance, there is no formal academic training for biosafety and biosecurity. U.S. CDC, along with local implementers, supported the training of medical laboratory professionals, biosafety and biosecurity staff at NPHL, and animal laboratory professionals at national and regional laboratories.

The Kenyan Veterinary Board requires all veterinarians and paraprofessionals to receive regular continuing education credits to retain their registration status. DVS has also used this opportunity to provide guidance on animal disease surveillance to private sector professionals. The Kenya Veterinary Association is among the dozen or so continuing education service providers accredited by Kenya Veterinary Board.

There is at least one veterinary officer in nearly every county and sub-county. Geographic distribution of the

animal health workforce is a challenge, especially in remote areas where insecurity is an issue. At the same time, mapping of existing non-clinical and animal health professionals has not been undertaken. Although veterinary workforce to WOAHA reporting indicates Kenya far exceeds the continental average, the number appears erroneous. It is understood that there are less than 3,000 Kenyan veterinarians, with only 600 active on the register according to the Kenya Veterinary Board as of 2022. The total ever registered since 1970 is less than 3000, including deceased members.

DISEASE MANAGEMENT

Surveillance and reporting

Disease surveillance is fragmented across the Ministry of Health, the Ministry of Agriculture Livestock and Fisheries, and the Kenya Wildlife Services, each of which has their own priorities data systems, and budgets that reduces the potential for coordinated approaches.

Human disease surveillance is undertaken by the Division of Disease Surveillance and Response. The types of reports submitted include: narrative monthly reports, notifiable and WOAHA listed disease reporting

forms, radio calls and telephone calls; rumor logs are also maintained. In 2016, Kenya transitioned to District Health Information System 2 (DHIS2). Limited budget and airtime, strikes by healthcare workers, and competing priorities affect whether and when health facilities report surveillance data. In 2008, KEMRI, with support from Wellcome Trust, established a Population Based Infectious Disease Surveillance (PBIDS) to collect data on zoonotic diseases within a limited study area in Siaya county. This is research-based surveillance that serves as a platform for various studies at KEMRI and its collaborating universities. The data is supposed to feed into the national surveillance system but this does not practically occur.

National animal disease surveillance is led by the DVS. The national government provides guidance to the CDVS, but there is no direct supervision between the DVS and each county. Animal health surveillance data sources include: Public sector veterinary doctors and veterinary paraprofessionals involved in surveillance activities or other field-based projects; Private sector veterinary doctors and veterinary paraprofessionals involved in veterinary practice; Kenya Wildlife Services (KWS); Public and private veterinary laboratories; Ports of entry; Livestock stock routes and markets; farmers and livestock keepers; Private and public abattoirs operating for local consumption or export; Export processing zones; and Veterinary research institutions and veterinary schools. This information is combined and submitted to the county disease reporting officers, who then submit it to the national level. Animal health surveillance reports or bulletins are sent on a quarterly basis to the counties, partners and other organizations. Private veterinarians in Kenya are currently mandated to report only notifiable diseases under the Animal Diseases Act (Box).

A newer animal disease surveillance platform known as the Kenya Animal Bio-surveillance system (KABS) has been instituted, which is a mobile data collection tool.

Box:
**Notifiable diseases included
in the Animal Diseases Act
(1965)**

- cattle plague (rinderpest)
- anthrax
- contagious bovine pleuro-pneumonia
- tuberculosis
- East Coast fever
- epizootic or ulcerative lymphangitis
- rabies
- foot and mouth disease
- sheeppox
- scab
- swine-fever
- swine erysipelas
- glanders
- farcy
- surra
- trypanosomiasis
- heartwater
- mange (scabies) in horses and mules
- bacillary white diarrhoea and pullorum disease
- fowl pest
- lumpy skin disease
- paratuberculosis (Johne's disease)
- atrophic rhinitis and scrapie

KABS was integrated into surveillance systems for domestic animals and wildlife in 2020. VEEU monitors surveillance data coming through the KABS system. This includes data collected by the animal health surveillance officers and wildlife surveillance officers through the KABS system as well as any other system collecting data from community animal disease

reporters including KABS-community, LivHealth, and SurveyToGo. VEEU issues alerts, notifications and early warnings to the counties concerned depending on their analysis of surveillance data. They also notify the DVS of any threats as detected by the surveillance system.

There is no specific budgetary line for animal disease surveillance at the national level and each county is responsible for identifying surveillance funds based on their individual budget. This leads to heterogeneous disease surveillance efforts between counties depending on the budget invested in those activities. Field investigations are the responsibility of each county involved and thus resources available for these activities vary across jurisdictions. In general, evident gaps in transportation and fuel limit the frequency of investigations, which are only done in ad hoc basis during an event.

KWS undertakes passive and opportunistic surveillance through investigations of morbidity and mortality events in wildlife across the country and reports to the DVS. The veterinary unit at KWS conducts surveillance and disease detection activities, including for zoonotic diseases. KWS is required to report all notifiable diseases to the DVS and WOA. Most surveillance activities conducted by the KWS are opportunistic, and are characterized by sample collection during activities such as animal relocation, in order to decrease stress during handling.

Kenya's wildlife sector has long had in place a government wildlife health system, with sustained some dedicated budget (even if limited), which is unique in the region. Real time reporting for surveillance is implemented through KABS and the Kenya Livestock and Wildlife Syndromic Surveillance (KLWSS). Ideally, KLWSS is supposed to feed into KABS, though this is not always the case. Disease reporting systems currently in use at KWS includes sanitary reports through VET-INFO, Kenya Animal Bio-surveillance System (KABS) and WOA reporting of listed and non-listed wildlife diseases by Wildlife Focal Person at KWS through the WOA Delegate based at DVS office.

Collaboration between the KWS and MoALF is limited, with field level coordination efforts hampered by low numbers of KWS veterinary staff. That being said, some county offices and KWS field stations do partake in joint activities when feasible, such as joint submission of disease reports. Challenges complicating wildlife disease surveillance include inadequate funding and personnel/lab capacity. There exists an initiative for event-based surveillance for seven syndromes in livestock and five syndromes in wildlife. Sentinel surveillance has been conducted in the past for Rift Valley Fever and HPAI, but funds do not exist for these activities regularly.

There is an attempt to institutionalize a One Health alert and notification system at the county level. The aim of the One Health surveillance system is to bring together diverse areas of knowledge, competencies, and type of expertise, to advance the effectiveness of the surveillance and early warning system. Early warning system effectiveness is compromised if the various actors in surveillance continue operating in silos. Sector champions will be necessary to push the operationalization of collaboration and data sharing ahead. The Directors of all the relevant directorates at the county level shall nominate a One Health surveillance champion who will be in charge of ensuring that surveillance resources and data is shared across the sectors, starting from the five initial counties and cascading to the rest of the 47 counties. MoH is working on strengthening and sensitizing community health volunteers to support their role in relaying information from early warning to communities and reporting suspect RVF cases.

External partners have made a number of electronic systems available for real-time reporting (e.g. S3LD, Survey2Go, KLWSS, Animal Resource Information System), however, many organizations support different tools that are not connected and there are limited efforts to integrate various animal health reporting platforms. The National One Health Strategy has outlined plans to making reporting fully electronic.

Access to diagnostics and vaccines

Diagnostics

The national laboratory system is comprised of the national reference laboratories at the Ministry of Health, medical research laboratories at the Kenya Medical Research Institute, teaching and referral hospital laboratories, Government Chemist laboratories, the National Public Health Laboratories (NPHL) and the Central Veterinary Laboratory. Kenya has the diagnostic capacity to test several priority diseases including foot and mouth disease, contagious bovine pleuropneumonia, highly pathogenic avian influenza, pestes des petits ruminant, African swine fever and Rift Valley fever through the national veterinary laboratory network as well as other highly pathogenic agents in BSL-3 laboratories at KEMRI, International Livestock Research Institute, and NPHL. Kenya does not have a BSL-4 laboratory and relies on external support from the U.S. CDC and South African reference laboratories.

In addition, personnel from all laboratories are available to conduct field investigations when needed, such as sampling sentinel herds during active surveillance efforts. Counties in the northern half of Kenya that are

Box:
**One Health Vaccine
Project for RVF**

The KEMRI-Wellcome Trust program is developing a single dose, long-acting vaccine for Rift Valley fever for use in humans and animals. Current vaccines for livestock require multiple doses, and antibodies from the vaccine cannot be differentiated from those against a new infection. No vaccine exists for humans. This vaccine may be registered for use in animals in Kenya in 2022.

far from any Regional Veterinary Investigation Laboratories may face more difficulties (e.g. cold chain maintenance, access to vehicle/gasoline) to efficiently use the laboratory network. Limited staffing and resources (e.g. reagents) restrict the activities of the laboratories, such as field investigations or diagnostic testing. A gap in updated training for personnel was also noted as some staff were unable to use recently acquired equipment due to of a lack of training. Test kits commonly used for zoonoses diagnostics are not validated and there is a lack of laboratories specialized in diagnosing wildlife diseases and a lack of validated laboratory tests for these diseases.

Vaccination

Through the Veterinary Vaccines Production Institute, Kenya has capacity to produce several vaccines (Newcastle, Bluetongue, CBPP, fowl typhoid, contagious pustular dermatitis, Rift Valley fever, Rinderpest, contagious caprine pleuropneumonia, FMD, lumpy skin disease, fowl pox, sheep and goat pox, and turkey pox). Kenya once produced vaccine for rabies, but it is no longer produced locally. KMRI collaborates on vaccine research (Box on vaccine project).

PREVENTION AND CONTROL MEASURES

ZDU, together with FAO and the German government, developed several national disease control strategies (Table on Strategic Plans). The strategic plans that were launched in February 2022 include the One Health Strategic Plan for the Prevention and Control of Zoonotic Diseases in Kenya (2021-2025), the National Strategy for the prevention and control of anthrax in humans and animals in Kenya (2021-2036) and the National Strategy for the prevention and control of brucellosis in humans and animals in Kenya (2021-2040).

Farmers routinely vaccinate against a number of priority diseases, including Foot and Mouth disease, Rift Valley fever, Peste des petits ruminants, Anthrax, and Rabies. Farmers pay for vaccinations at a subsidized rate. For

Table.
National Disease Control Strategic Plans and Contingency Plans

DOCUMENT	MAIN OBJECTIVE	YEAR PUBLISHED	TIMELINE
Strategic Plan for elimination of Human Rabies in Kenya	Eliminating dog mediated human rabies in Kenya by 2030	2014	2014 - 2030
National Contingency Plan for Rift Valley Fever	Coordinated national strategy to prepare for, and respond to a RVF outbreak disaster	2014	
Highly Pathogenic Avian Influenza Contingency Plan	Prevent and control incursion of HPAI virus in Kenya and develop early warning and rapid response protocols for HPAI	2008	
National strategy for the prevention and control of brucellosis in humans and animals in Kenya	Diagnosis and surveillance, preparedness and response, prevention and control of brucellosis at the national and subnational levels in Kenya	2022	2021 - 2040
National Strategy for Prevention and Control of Anthrax in Kenya	Guidelines for systematic reduction of anthrax in livestock, wildlife and humans in Kenya	2022	2021 - 2036
National Action Plan on Prevention and Containment of Anti-microbial Resistance	Provide a coherent policy framework and priority actions to contain the emergence and spread of anti-microbial resistance	2017	2017-2022
Animal Health Surveillance Strategic Plan	To optimize surveillance and reporting of animal diseases	2018	2018 - 2023
One Health Strategic Plan for the Prevention and Control of Zoonotic Diseases in Kenya	To reduce the burden of priority zoonotic diseases through the strengthened implementation of the One Health approach at the national and county levels and the promotion of applied research to fight those diseases using the One Health approach	2022	2021-2025

Box:
**Collaboration on One
Health activities in Kenya**

- Research has been conducted on Q-fever, Brucellosis, Rift Valley fever, Rickettsia, Leptospirosis and Middle East respiratory syndrome coronavirus (MERS-CoV) by the Department of Veterinary Services, KEMRI, the Division of Global Health Protection, and Wellcome Trust, in collaboration with the ZDU.
- Since 2015, U.S. CDC and KEMRI, in collaboration with Washington State University, have been conducting livestock syndromic surveillance in Western Kenya to measure impact of livestock diseases on human health and socio-economic status of households.
- The Institute of Infection and Global Health, University of Liverpool, and the International Livestock Research Institute (ILRI) have established the Zoonotic and Emerging Diseases research group (ZED group) in Kenya. Projects under this initiative include: Zoonoses in Livestock in Kenya (ZooLink); Pathogen and Disease ecology in bats, an Urban Zoo project; People, Animals and their Zoonoses (PAZ) project; and the One Health Regional Network (HORN) Project.
- The Ohio State University Health Sciences' "Ohio Global One Health Initiative" focuses on improving the capacity of pre-service health professionals in Kenya working with the University of Nairobi and KEMRI.
- The Fleming Fund, through FAO, is supporting a review of legislation relevant to AMR, a baseline review of antimicrobial use in agriculture, including data on the veterinary medicines supply chain, and communication activities to raise awareness and understanding of AMR in the livestock and veterinary sectors.

rabies, farmers are encouraged to bring dogs and cats during routine vaccination for other livestock diseases, since they are primary owners of domestic dogs. Veterinary associations also mobilize rabies vaccination campaigns for World Rabies Day. The government also conducts mass vaccination campaigns in urban areas, particularly in schools for initiatives targeting children. Historically, vaccination has been conducted by the government, but as of 2020, the private sector has been approved to conduct vaccination. This is likely to lead to a rise in the cost of vaccinations due to the absence of government subsidies. The private sector, therefore, will need to engage with county authorities

to explore the business opportunities along the vaccine delivery value chain such as procurement (from pre-approved distributors), conducting publicity campaigns and vaccination.

ETHICS

County governments are responsible for animal welfare. ILRI, based in Nairobi, has an Institutional Animal Care and Use Committee.

KENYA CASE STUDY:

Rift Valley Fever

CURRENT STATUS

Rift Valley fever is a mosquito-borne zoonotic disease primarily affecting domestic animals (such as sheep, goats, and camels). Human cases occur from contact with infected animals/animal products. Major mosquito hosts that transmit to livestock are *Aedes* and *Culex* genera; amplification occurs in the infected animals, which can lead to onward spread to humans. RVF transmission may potentially involve many species of mammals and mosquitoes. The virus can be transmitted in mosquito progeny via the eggs (vertical transmission). It is plausible that the virus may be found in ticks, but screening has not been conducted for the presence of the RVF virus in ticks in Kenya. Seroprevalence studies in wildlife have detected RVF virus, but the significance of this to outbreaks in domestic livestock in Kenya is not well understood. Many more cases are detected in livestock than in humans, even though people may experience a case fatality rate of up to 30%. Understanding RVF ecology and epidemiology, awareness of the risk factors for RVF infection, integrated vector control activities, and protective measures against mosquito bites are all among important aspects for a One Health approach to reduce risk and impact of the disease.

RVF outbreaks are recurrent in Kenya (with recent outbreaks in 1998, 2006-2007, 2014, 2018 and 2021). In particular, the 2007 outbreak resulted in serious economic consequences. Human cases are mainly linked to contact with infected livestock. In 2021, Kenya experienced human and animal cases in four counties, resulting in 11 deaths as of February. In three counties (Isiolo (Ewaso Nyiro), Mandera (Dawa) and Garissa), the disease was associated with river flooding. In Muranga, outbreaks were recorded near swampy areas and quarries, but not linked to above-average flooding/rainfall specifically. Despite meeting the suspect case definition, cases do not always seek health care.

HIGH-LEVEL STRATEGIES

In 2021, DVS and MoH collaborated with ILRI on an animal vaccination campaign in Isiolo County.⁴⁰ ILRI gave vehicles and bought vaccines (80,000 doses of the Smithburn strain) from KEVEVAPI. The ZDU is

working with local community-based non-governmental organizations such as Comitato Collaborazione Medica (CCM) to convey early warnings, raise awareness, train human and animal health workers on case detection, management and reporting as well as sensitize community health volunteers and local veterinarians on emergency preparedness and response. In 2015, a South African registered RVF vaccine (known as Clone 13 vaccine) was tested by the US CDC and found to be effective for livestock use. However, approval for use in animals in Kenya has been hampered by reports of abortions during the trial phase. The vaccine demonstrated high immunogenicity (>90%) in sheep and goat and moderate immunogenicity (>65%) in cattle.⁴¹

A new single-dose, long-acting vaccine (ChAdOx1 RVF vaccine) capable of protecting both humans and livestock is currently under development via the KEMRI-Wellcome Trust program. This is intended to

KENYA CASE STUDY:

Rift Valley Fever

replace the current livestock inactivated vaccine that needs multiple doses to elicit a good immune response. Antibodies against the current vaccine used in animals cannot be differentiated from those due to a new infection, and there are currently no licensed vaccines for human use. The multi-species vaccine is envisioned to reduce the overall cost of vaccine production. It can be used safely in pregnant animals. Field trials for use in animals have been done and data analysis is ongoing; licensure for animal use could potentially be done in 2022. The human vaccine trial (Phase 1) has been done for safety and immunogenicity; field trials are yet to begin.

SURVEILLANCE

RVF has been included into the weekly disease outbreak Situation Report (SitRep). There is enhanced community-based surveillance under a One Health approach in vulnerable pastoral counties of Northern Kenya. The Central Veterinary Laboratory at Kabete has capacity for ELISA IgG/IgM antibody testing, the Kenya Medical Research Institute (KEMRI) has capacity for PCR testing, and the ILRI laboratory in Nairobi has capacity for sequencing and genomic analysis.

An open-source tool has been developed by ILRI to support lineage classification from RVFV sequence data, which could help to improve epidemiological investigation (particularly regarding outbreak origin) and target surveillance and vaccination.

Risk-based syndromic surveillance is informed by rainfall monitoring. In May 2018, reporting from the Kenya Meteorological Department indicated high rainfall levels (3x the expected annual amount) in North Eastern region of Kenya. This prompted the Kenya Directorate of Veterinary Services (KDVS) to activate a community-based, syndromic surveillance system to monitor RVF-linked disease in livestock. The system was also utilized in 2015–2016 in 22 counties determined to be at high risk. However, as of 2018, a

delay in the detection of a human suspect case and laboratory confirmation was still reported. Low suspicion of the disease among healthcare providers and the nonspecific symptoms likely contribute to such delays.⁴²

For community-based syndromic surveillance, no routine screening for Q-fever or *Brucella abortus* is done concurrently because they are not perceived by the MoH to be as dangerous to humans as RVF. However, specimens from aborted animals are usually taken for confirmation of RVF (with differentials being Q-fever and *Brucella* spp). The downside of this is that no specimens will be available in case abortions are averted due to early mitigation measures such as indoor residual spraying following early warnings for RVF.

The DVS has established sentinel herds for RVF monitoring, located in Naivasha and Kitale, Maseno, Bachuma and Machakos government farms. Continuous surveillance is conducted, as well as targeted surveillance prior to and during periods of rain, aiming to support early warning.

There is not a systematic approach to vector surveillance or vector management in the country. Insecticide resistance has been examined to a limited extent for malaria-transmitting mosquitos.

PREVENTION AND CONTROL

The inclusion of RVF in the weekly outbreak situation reports (SitReps) is a move aimed at early detection of the disease. The ZDU is working with local community-based non-governmental organizations to raise awareness, train human and animal health workers on case detection, management and reporting as well as sensitizing community health volunteers and local veterinarians on emergency preparedness and response. Early detection is made possible through sensitive community case definition, zero reporting, training of reporters/community members on clinical sign recognition and use of sentinel herds. Government

officials, farmers, livestock traders and community members are involved in RVF surveillance and reporting.

During the last outbreak in 2021 in northern Kenya, a multiagency team comprising WHO, FAO and WOAHA among others undertook the following activities:

- Outbreak investigation including vector surveillance, and ecology mapping
- Training of health care workers including capacity building on RVF case detection and appropriate case management
- Raising awareness via radio spots, printing and dissemination of Information, Education and Communication (IEC) materials
- Building capacity of the County laboratories to carry out tests for RVF and other diseases
- Ante and post-mortem livestock inspections
- Sensitization of community health volunteers, healthcare workers and veterinarians
- Planning of updating and reviewing the RVF contingency plan (last version 2014)

In 2019, Kenya piloted a national Joint Risk Assessment (JRA) training, convening multisectoral experts. Rift Valley fever and Rabies were indicator zoonotic diseases whose risk was assessed, matrix scored, and impact and likelihood weighted. A national JRA steering committee was established and tasked to work with technical teams, with joint leadership by the CDVS and Director General. In 2021, the JRA operationalization process targeted human, livestock, wildlife, and environmental experts from zoonoses high risk counties. County One Health Units were recommended to do the following: Establish priority zoonotic diseases technical teams; Expand the pool of JRA experts both at the national and subnational level; and Operationalize

the risk assessment of priority zoonotic diseases on a need basis.

REGIONAL CONSIDERATIONS

RVF threatens the livelihoods of the pastoral community dependent on livestock production. Under an FAO initiative to harmonize control strategies in East Africa, a regional plan of action was developed at a high-level meeting in Tanzania in 2018. Specific aspects for attention included vaccine type, quality, and safety, regional reference laboratories, and establishing sentinel herds. In addition, the EAC mobile laboratory network is supporting timely and accurate diagnosis of BSL-3/4 pathogens, which can help support earlier detection of RVF cases.

IMPLEMENTATION GAPS

- Insufficient training of both human and animal health workers, including capacity for RVF case detection and appropriate case management in humans and animals
- Outdated RVF contingency plan (last updated in 2014)
- Low awareness by community health volunteers, healthcare workers and veterinarians impedes timely case management and reporting
- No systematic vector surveillance and control strategy
- Inadequate routine animal vaccination against RVF
- Inadequate risk reduction stance for those at increased risk of infection (i.e. herders, farmers, abattoir workers, veterinarians)

Rift Valley Fever

KEY RECOMMENDATIONS

- Enhance public awareness and public education on RVF, to improve reporting especially in pastoral areas prone to outbreaks
- Raise awareness via radio spots, printing and dissemination of Information, Education and Communication materials, especially in Northern pastoral counties
- Strengthen capacity of County laboratories to carry out tests for RVF and other diseases
- Reestablish animal quarantine sites (now allocated to private individuals) as holding grounds in order to control livestock movement
- Reduce risk of animal-to-human transmission from unsafe animal husbandry and slaughtering practices, risk of animal-to-human transmission from the unsafe consumption of raw or unpasteurized milk or animal tissue; and risk of mosquito bites through the implementation of vector-targeted interventions
- Enhance surveillance, including early warning and detection surveillance system for animal health, environmental monitoring, case surveillance and other measures in line with the One Health approach
- Conduct routine preventive animal vaccination and raise awareness about risks of vaccination during an active epidemic (infection spread through contaminated needles)
- Develop and implement a national vector surveillance and management plan
- Review and update the RVF contingency plan

EAST AFRICA ENDNOTES

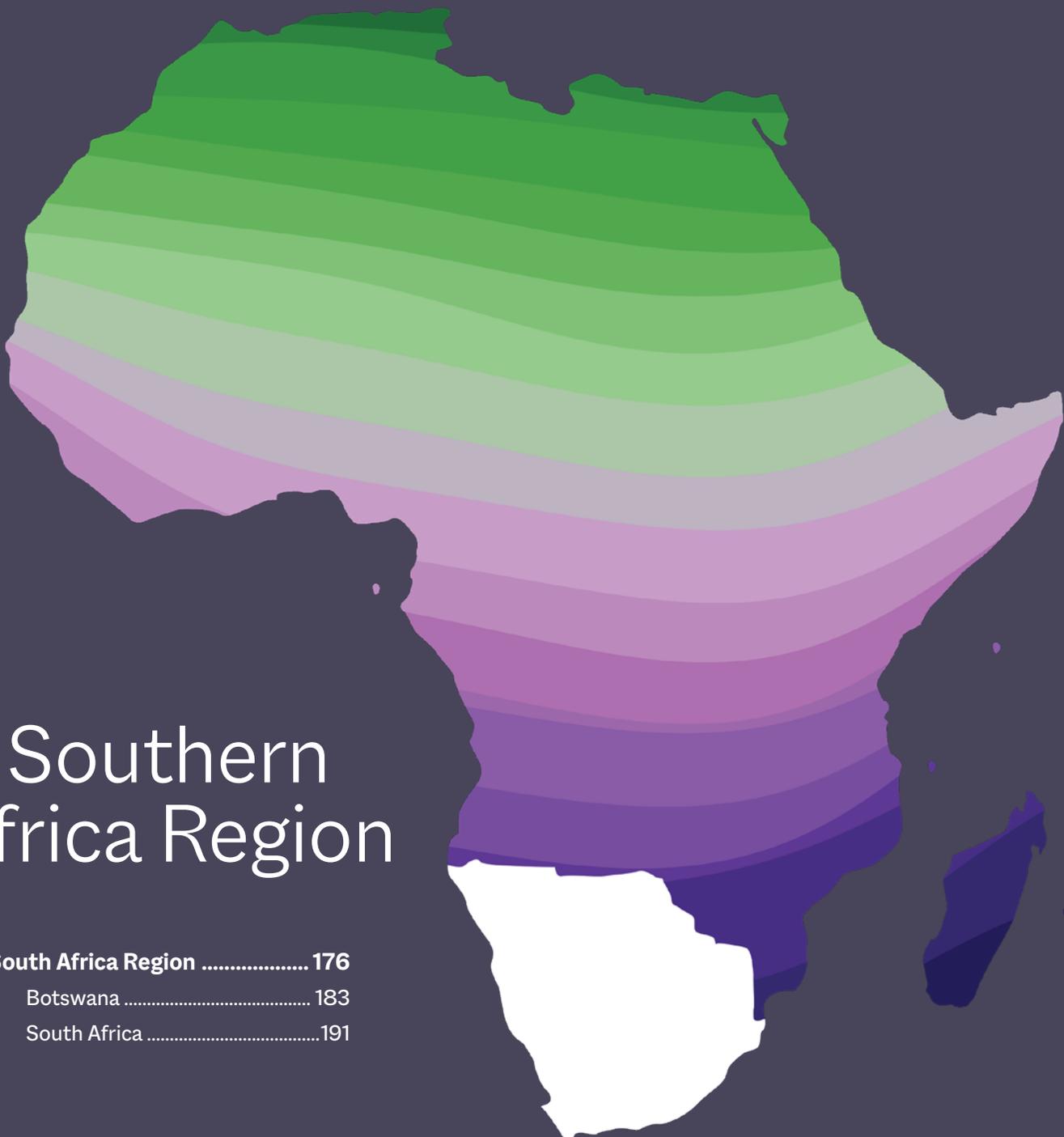
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Southern Africa Region

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Southern Africa Region

CONTEXT

The Southern Africa region is defined by United Nations as Botswana, Eswatini, Lesotho, Namibia, and South Africa. Several countries in the East Africa region (e.g. Malawi, Mozambique, Zambia, Zimbabwe) are also often discussed in the context of Southern Africa.¹

The region is dependent on commodities, chiefly natural resource extraction and agriculture. Migration is driven by employment opportunities, including in the mining sector, in South Africa and Botswana.² The region is highly vulnerable to climate change, especially extreme weather events and droughts. Since 2012 the Southern Africa region has only had two years of favorable agricultural conditions due to a multi-year drought.³ The region's food insecurity in 2019-2020 increased by 7.4% compared to levels recorded during the 2016-2017 El Niño-induced drought, with the greatest increases noted in Mozambique, Eswatini, Zimbabwe, and Zambia. Agricultural production systems vary widely in the region, with a mix of communal and large-scale commercial livestock farms in close proximity in some countries; artisanal fishing also plays a substantial role in the livelihoods and nutrition of some populations.

In addition to challenges presented by common livestock diseases, the region has experienced outbreaks of emerging and endemic diseases such as Marburg, Rift Valley fever and rabies virus. Southern Africa still faces the highest burden of HIV/AIDS, though has made significant advancements in reducing transmission and increasing access to treatment. Multidrug-resistant tuberculosis is a high concern for the region, particularly South Africa.

Protected areas play an important role in wildlife protection as well as tourism in the region. Wildlife-livestock interactions are considered a source of disease risk, both for introduction and transboundary spread, as well as human-wildlife conflict. Southern Africa has a long history with implementing veterinary cordon fences to limit interactions and retain their disease-free status to be able to engage in international export markets. This practice is recently being re-examined to balance concerns for wildlife and biodiversity, including animal migration. Serious vulture declines — increasingly recognized as an issue in other parts of the continent too — are well documented in Southern Africa, linked to a mix of habitat loss and poisoning associated with poaching events and efforts to control other wildlife (e.g. predators that may be seen as a threat by livestock farmers).

CURRENT SITUATION

Regional coordination and governance initiatives

The Southern African Development Community (SADC) is a regional economic community that aims to advance economic development, peace and security, and growth in its 16 member states: South Africa, Lesotho, Eswatini, Mozambique, Botswana, Zimbabwe, Namibia, Angola, Zambia, Malawi, Tanzania, Democratic Republic of Congo, Madagascar, Seychelles, Comoros, and Mauritius. Half of the SADC member states are also included in the Common Market for Eastern and Southern Africa (COMESA).

The SADC Secretariat is primarily responsible for implementing and coordinating the objectives and activities outlined by the SADC Regional Indicative Strategic Development Plan (RISDP) 2020-2030 by coordinating and facilitating regional resources.

SWOT ANALYSIS | SOUTHERN AFRICA REGION

S

STRENGTHS

SADC policies and strategies in place related to disease control, conservation, and addressing illegal wildlife trade

Quantity and productiveness of veterinary training institutions

Willingness to regulate veterinary drugs and AMR issue

Availability of vaccine production and reference laboratories

Cross-regional collaborations between Southern and Eastern Africa

Unique expertise and research capacity on several One Health-relevant topics: entomology, wildlife toxicology, anti-poaching innovations, and protected area management

W

WEAKNESSES

Dependence on donor funding

Disease-specific surveillance systems are currently dependent on external donors

Amount of veterinary services budget that goes towards maintaining veterinary cordon fences and classical livestock diseases

Limited sharing of surveillance data among SACIDS partner

Uneven funding and resources across SADC Member States

Weak national regulatory systems, financial problems, lack of regional institutional capacity and challenges related to human resources

No regional emergency response systems

Staffing and resources, particularly for emergencies, are made available on an ad hoc basis

O

OPPORTUNITIES

Regional research and knowledge exchange through robust academic institutions

World Bank Eastern and Southern Africa One Health Regional Initiative

Efforts to strengthen COVID-19 surveillance at points of entry

Transboundary and national early warning system development

T

THREATS

Limited number of veterinary training institutions

Limited preparedness against the effects of climate change and other environmental degradation on agricultural and disease risks

Growing challenges related to antimicrobial and insecticide resistance

Southern Africa

Member States are responsible for implementing the strategy at a national level. SADC has developed several instruments and programs for the control of infectious diseases, and natural resources and environment protection, with varying degrees of implementation across the region (Table on Policy Instruments).^{4,5}

These include instruments for rabies elimination, addressing pestes des petits ruminants (PPR) and foot and mouth disease (FMD), surveillance and control of transboundary crop and animal pests, and a strategy for law enforcement and anti-poaching.

In May 2022 SADC hosted a Joint Meeting of Ministers Responsible for Agriculture and Food Security, Fisheries and Aquaculture, noting the constant pressures faced from crop and livestock pests and diseases in the region. The importance of interdisciplinary mechanisms was expressed, including through implementation on the Water-Energy-Food Nexus Framework and Disaster Risk Reduction Mainstreaming Guidelines for the Agriculture Sector (which consider environmental health).⁷

SADC has established a Monitoring, Control, and Surveillance Centre to combat illegal, unreported, and unregulated fishing. It has also established 19 Transfrontier Conservation Areas (TFCAs), which are currently at different stages of development.⁸ The

Table.
Examples of SADC Policy Instruments and Strategies

INSTRUMENT	SCOPE
Regional Biodiversity Strategy	<ul style="list-style-type: none"> - Address inadequate biodiversity monitoring and inventory systems, inadequate incentives for biodiversity conservation, weak institutional and legal frameworks, and limited and unsustainable funding for program implementation - Develop a comprehensive inventory and monitoring systems for key species - Enhance the economic value of biological resources - Strengthen institutional and legal implementation frameworks for biodiversity initiatives - Develop appropriate research and development approaches for initiatives and program.⁶
Protocol on Fisheries	<ul style="list-style-type: none"> - Protect resources against overexploitation, transfer skills and technology, exchange of information regarding the state of shared resources among Member States
Protocol on Forestry	<ul style="list-style-type: none"> - Harmonize sustainable forest management approaches, forest policy, legislation and enforcement.
Protocol on Wildlife Conservation and Law Enforcement	<ul style="list-style-type: none"> - Develop common approaches to the conservation and sustainable utilization of wildlife (excluding forestry and fishery resources) resources - Ensure the effective enforcement of those national laws governing these resources - Promote sustainable use of wildlife resources, harmonization of legal instruments governing wildlife use and conservation, the enforcement of wildlife laws, facilitation of information exchange, and building national and regional capacity for wildlife management and conservation

Transfrontier Conservation Areas Financing Facility aims to provide fast responses to emerging needs of TFCAs in the region, with support from Germany from 2020-2026.⁹ The Kavango-Zambezi and the Great Limpopo TFCAs are the largest in the region. The Great Limpopo TFCA encompasses five countries — Angola, Botswana, Namibia, Zambia, Zimbabwe.

The World Bank announced in June 2022 that it will be launching an Eastern and Southern Africa One Health Regional Initiative informed by an analysis in Botswana and Namibia, which will aim to strengthen knowledge sharing and human resource capacity in the region.¹⁰

Regional diseases of concern and relevant risk management measures

Transboundary diseases pose a serious threat to intra- and inter-regional trade. There have been recent outbreaks of FMD, Highly Pathogenic Avian Influenza (HPAI), Rift Valley fever, African swine fever, and African animal trypanosomiasis.¹¹ Wild and domestic animal interactions are a key interface for disease transmission, including for FMD, rabies, and zoonotic tuberculosis. Outbreaks have had severe implications for the trade of livestock and livestock products with foreign partners, such as the European Union.

TFCAs have presented a challenge for managing transboundary diseases where wildlife interact with livestock from surrounding rural communities that share pasture and water with wildlife, humans, and other livestock.¹² Many Southern African countries employ veterinary cordon fences. Namibia's runs the width of the country separating it into FMD and Contagious Bovine Pleuropneumonia (CBPP) free and control zones. South Africa's Kruger National Park has a game-proof fence along its western boundary. Countries employ several management measures, specifically for FMD, including livestock identification and traceability measures (e.g. Botswana's Livestock Identification and Trace Back System), regular vaccination campaigns, and compulsory slaughter of infected and in-contact animals.

A significant portion of national budgets for veterinary services is spent on FMD-related control measures.¹³ FMD-free zones and negotiating access to foreign beef markets has been one of the key ways countries in the region have navigated the negative economic effects of FMD. However, establishment and maintenance of disease-free zones, particularly in the vicinity of large TFCAs which seek to connect wild animal populations, has presented challenges, including for biodiversity management.¹⁴

HPAI is another disease of concern, especially given the path of migratory birds in the region. Outbreaks have occurred in Southern Africa in 2021 and 2022, which affects trade of eggs and poultry products and wild fowl. Building on an existing strategy, an updated SADC regional HPAI preparedness and response plan was developed in 2018, which includes guidance on control options as well as coordination mechanisms between and within countries.¹⁵

Disease events also threaten free-ranging and captive wildlife populations. For example, the H5N8 HPAI epidemic affected African Penguin populations in Namibia and South Africa, adding to existing declines linked to limited food availability and environmental degradation.¹⁶ Rabies virus and distemper outbreaks have affected wild carnivore populations in the region.

Regional prevention and control measures

SADC oversees the Southern African Centre for Infectious Disease Surveillance (SACIDS). SACIDS is a regional body that links academic, government agencies, and research institutions in Southern (and Eastern) Africa for the detection, identification, and monitoring of zoonotic diseases,¹⁷ with a focus on the Democratic Republic of Congo, Mozambique, South Africa, Tanzania, and Zambia. There is a strong focus on virtual participation. Key challenges reported have been limited data sharing among partners, uneven funding and resources across member states, and delays in implementation. SACIDS is supported by external funding, including foundations.

Southern Africa

Africa CDC found that among Malawi, Mozambique, South Africa, Zimbabwe, and Zambia, there is limited sharing of surveillance data across the region and information sharing and cooperation occurs on an ad hoc basis. There are no regional emergency response systems, and capabilities and staff are shared on an ad hoc basis.

There are two key livestock vaccination production hubs in the region. Botswana's Veterinary Institute provides the region's vaccines for FMD and PPR that have been incorporated into European Union and WOAAH-supported vaccine banks. South Africa's state-owned Onderstepoort Biological Products (OBP) produces vaccines for Anthrax, Rift Valley fever, Brucellosis, and lumpy skin disease, among others.

South Africa has seven WOAAH-designated reference laboratories.¹⁸ The Botswana Veterinary Institute serves as the WOAAH Regional Reference Laboratory for FMD. South Africa's National Institute for Communicable Diseases contains the only BSL-4 laboratory in Southern Africa.

Regional training pipelines and research collaborations

Veterinary training is available in South Africa (University of Pretoria), and Botswana (Botswana University of Agriculture and Natural Resources). Many veterinarians are entering the private and small animal sector, which has limited support for the livestock sector, particularly for smallholder and communal farmers. In South Africa, for instance, the supply of veterinary education cannot meet demands on in-service veterinarians.

In collaboration with AFENET, Field Epidemiology Training Programs have been conducted in Angola, Malawi, Mozambique, South Africa, Zambia, and Zimbabwe. In August 2022 an FETP Southern Africa conference was held, with the theme of "Strengthening Health Security through Evidence-Based Public Health Interventions in Southern Africa and beyond".

Other in-service training initiatives with a One Health scope are happening at national levels, on a variety of topics. For example, in Eswatini a Fleming Fund initiative is supporting in-service training in the context of AMR surveillance, epidemiology, and laboratory enhancements, including toward the development of a One Health coordination mechanism.

Box. Regional and Cross-Regional initiatives

SACIDS is collaborating with EAIDSNet on several projects around surveillance. One includes piloting a mobile technology approach to disease surveillance with funding from the Rockefeller Foundation. The project operates in Tanzania, Zambia, and Burundi. They have also launched a project (Enhancing Community-Based Disease Outbreak Detection and Response in East and Southern Africa), which aims to create mobile and participatory surveillance tools. Africa CDC, SACIDS and EAIDSNet have also collaborated on COVID-19 surveillance and diagnosis in selected countries considered to be at especially high risk.

In collaboration with IZSAM, national veterinary laboratories in Botswana, Mozambique, Namibia, Zambia, and Zimbabwe were the first to adopt the "SILAB for Africa" Laboratory Information Management System. The program has since expanded to 18 African countries, in collaboration with FAO.

The Southern Africa Bat Research Network, led by University of Pretoria in collaboration with international partners, is bringing together transdisciplinary research on bat ecology, viral diversity, and human behavior to better understand and mitigate spillover risk. Several disease-specific research projects are being undertaken in the region.

Botswana, Malawi, Mozambique, Namibia, Zambia, and Zimbabwe are included under the Capacitating One Health in Eastern and Southern African project (2021-2025) through ILRI, CIRAD and the European Union.

REGIONAL PRIORITIES AND COMMITMENTS

Indications of interest and commitments to take on One Health and veterinary programs and systems strengthening

Several countries have initiated national One Health coordination bodies; however, in general these appear less advanced than in other regions, with more limited government prioritization of these efforts and less government-government knowledge exchange. In the context of protected areas, the Trilateral Cooperation Project is supporting an IUCN-implemented project in Namibia and Zambia in collaboration with China and Germany. Under this project, a key focus is the implementation of the Green List Standard for Protected and Conserved Areas, including a formation of an expert assessment group for the certification process. In Zambia, this project is run through the Department of National Parks and Wildlife, in collaboration with experts from academic institutions (e.g. Copperbelt University). In line with a One Health approach, veterinary and wildlife experts are providing input to IUCN on potential health indicators for the revision of the Green List Standard.

The region's high research capacity, and vulnerability to a range of climate-related pressures, among them drought, floods, cyclones, and heat waves, reinforce the potential of early warning systems to support increased preparedness and resilience. In collaboration with the World Meteorological Organization, a pre-COP27

ministerial meeting is being held on the "Integrated Early Warning and Early Action System Initiative" to advance collaboration in Southern Africa, including through the SADC Humanitarian and Emergency Operations Centre.¹⁹

Opportunities to leverage regional COVID-19 activities

SACIDS and EAIDSNet have supported the project "Strengthening SACIDS Expert Support to Regional COVID-19 Emergency Preparedness in Southern, Central and East Africa" which has aimed to support Ministries of Health and public health laboratories in the region.²⁰ The project supports targeted disease event surveillance at ports of entry and cross-border areas, contact tracing, rapid diagnostic capabilities, and enhanced risk analysis and risk communication. The establishment of the mRNA Vaccine Technology Transfer Hub, based at Afrigen in South Africa and in collaboration with the South African Medical Council and Biovac, is intended to support capacity development within South Africa and in five other countries for vaccine production.

STATUS OF ONE HEALTH AND VETERINARY SYSTEMS

The Department of Veterinary Services (DVS) falls under the purview of the Ministry of Agricultural Development and Food Security, which is responsible for agriculture development and food security. The Ministry also oversees the Department of Animal Production as well as the Botswana Vaccine Institute and Botswana Meat Commission, which are both parastatals. There are 10 District Veterinary Offices and 28 Sub-district Veterinary Offices. Districts are divided into extension areas and then into 8-10 crushpens. Crushpens are staffed by an animal health technician and supervised by a state veterinarian. As of 2020, DVS' recurring budget is primarily targeted towards addressing foot and mouth disease, pest and disease control, and quarantine camps.

Under the PVS pathway, DVS has updated and continues to update veterinary legislation, including to

Southern Africa

address AMR (along with the Ministry of Health and Wellness) and animal welfare. This included an official PVS Legislation mission in 2015, further work in the PVS Evaluation follow-up in 2019, and ongoing work to amend the current laws.

Emergency funding in response to animal disease outbreaks is made available via the Cabinet of Botswana. However, the process of acquiring funding and competing priorities from other sectors can present challenges to accessing this resource.

DVS collaborates with the Department of Wildlife and National Parks (DWNP) under the Ministry of Environment, Natural Resources, Conservation and Tourism. DWNP provides support on engaging with wildlife. For instance, DWNP supports DVS during buffalo incursions by guiding them back into the parks. In addition to funding from government partners, there is external funding through agencies such as UNDP (via the Biodiversity Finance Initiative), UNEP (Poverty-Environment Initiatives) and the European Commission. Wildlife surveillance is not routinely conducted.

The Ministry of Health and Wellness has announced the intention to establish a national Public Health Institute. Under TEPHINET, the U.S. CDC and International Association of National Public Health Institutes are partners in the development of this Institute. The Institute would combine surveillance, laboratory, preparedness, and emergency response. One Health coordination is also intended in its activities, including aligning human health, animal health, and environmental health laboratories.

Cross-national committees exist for transborder diseases. In 2018, Namibia and Botswana signed a treaty to provide a mechanism for controlling transboundary diseases.

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Botswana



Completed Assessments and Plans

JEE	PVS Evaluation	PVS Evaluation Follow-Up	PVS Gap Analysis	PVS Legislation	IHR-PVS Bridging Workshop	NAPHS	OHZDP	National AMR Action Plan	NBSAP
2017	2010	2019	2011	2015	-	2020	-	-	2016

Indicator **Country** **Region Average** **Continent Average**

Coordination and Financing

Multi-sector and One Health collaboration/coordination for AMR (1-5)	–	3.00	2.44
Current health expenditure per capita (USD)	481.53	368.75	132.25
Collaborative effort on activities to address zoonoses (0-100)	20.00	48.00	54.23
CFE disbursements (USD)	0.00	295,395.50	4,903,032.44

Workforce

Veterinarians (total)	767.00	1,522.00	3,512.00
Veterinarians (per 1,000 people)	0.34	0.39	0.17
Public animal health professionals (total)	85.00	59.00	461.00
Public animal health professionals (per 1,000 people)	0.04	0.02	0.02
Medical doctors (total)	853.00	9,993.00	8,574.00
Medical doctors (per 1,000 people)	0.38	0.50	0.41
Up-to-date multisectoral workforce strategy (1-5)	2.00	1.80	2.19
Progress with strengthening veterinary services (1-5)	–	4.00	2.80

Demographic Factors

Population (total)	2,303,703.00	13,325,978.80	24,185,802.76
Population growth (% , 2010-2019)	15.90	12.44	23.73
GNI per capita (USD)	7,510.00	4,864.00	2,525.37

Environmental and Sanitation Factors

Land area (sq km)	566,730.00	530,134.00	548,414.71
Arable land (% land area)	0.46	7.13	14.14
Forest area (% land area)	27.13	15.87	27.57
Terrestrial protected areas (% land area)	29.14	15.98	16.27
Average primary forest loss (ha)	–	687.29	20,326.14
Access to basic drinking water – rural (%)	75.50	69.02	55.48
Access to basic drinking water – national (%)	90.30	80.62	69.76
Access to basic hygiene – national (%)	–	28.70	26.71
Access to basic sanitation – national (%)	77.30	57.74	40.71

Animal Factors

Average livestock stocks (LSUs)	1,068,864.41	3,654,307.56	5,551,123.37
Average livestock exports (LSUs)	4,068.04	43,602.71	33,314.93
Average livestock imports (LSUs)	10,594.34	64,740.74	31,044.50
Mammal species (number)	203.00	220.60	241.65

STATUS OF ONE HEALTH AND VETERINARY SYSTEMS

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One Health Coordination

Currently, there is no formalized One Health platform in Botswana. However, disease-specific multisectoral working groups exist. An antimicrobial resistance working group was established in 2017 with representation from human health, animal health and the environment. According to the PVS (2019), a National Technical Committee for HPAI was established to address previous outbreaks, with engagement from the DVS, Ministry of Health and Wellness, and Department of Wildlife and National Parks (under the Ministry of Environment). The National Disaster Office also has multi-sectoral representation, which meets regularly even when an emergency is not occurring.

Training Pipelines

Botswana's veterinarians are trained abroad, since the country does not have its own veterinary school. The Botswana University of Agriculture and National Resources has a Faculty of Animal Veterinary Sciences, which graduates para-veterinarians and also offers certificates for meat inspection. In addition, the Okavango Research Institute (ORI), based at the University of Botswana, conducts research on climate change, ecosystem services and dynamics, sustainable

SWOT ANALYSIS | BOTSWANA

S

STRENGTHS

Ministerial support for One Health in individual policies

Ongoing review of veterinary legislation underway to meet current and emerging needs

Monitoring of antimicrobials in humans and animals, including use of veterinary drugs

Vaccine production in-country, and supports region

Quality of animal laboratories, including international accreditation, quality management, and reference laboratory status

Extensive country coverage of veterinarians, including employment within the national veterinary services, wildlife department, natural resources institution and the private sector

Investments in human resources at DVS

W

WEAKNESSES

Lack of formal One Health platform

No financial resources to implement programs related to zoonoses or One Health program.

Lack of baseline data (e.g. on abuse in farm animals, Prescription patterns, Prevalence of zoonotic diseases and impact of AMR)

Low stakeholder awareness of One Health, particularly at sub-national levels

Limited involvement of other sectors such as environment

Poor chain of command on surveillance, particularly among district teams, delays response

Poor management of health information, including paper-based records for animal disease surveillance, and untimely data collection, collation, analysis, interpretation and dissemination of information

Emphasis on response versus prevention

National Action Plan for AMR has yet to be endorsed by the government

No national laboratory or laboratory system that tests for priority antimicrobial resistant (AMR) pathogens

No disease or pathogen surveillance conducted in wildlife

Surveillance data not routinely shared across sectors

O

OPPORTUNITIES

New FMD policies and approach to cordon fences

Routine multi-sectoral meetings via National Disaster Office could help facilitate information sharing

Utilize official social media channels for dissemination of information on ongoing activities such as surveillance, risk assessment, data collection, communication strategy

Mobile technology and text messaging is in place to report malaria, TB and other diseases and promote public health-related guidelines; this approach could be transferred to animal diseases

Expand antimicrobial residue monitoring program (in place through external support) to AMR monitoring

T

THREATS

Impact of transboundary animal diseases on livestock sector

Amount of human and financial resources of the animal health sector that FMD control consumes due to political desire to align with international partner wants (potentially at the expense of other disease issues)

Turnover of trained staff, and the potential for the rural public sector workforce pipeline to be disrupted by a growing demand for private veterinary care in urban areas

tourism, and water resource management.

Despite not having its own veterinary school, Botswana's veterinary coverage (veterinarians per 1,000 people) is well above the continent average. According to the PVS Evaluation Follow-Up (2019), veterinarians are employed in the Department of Veterinary Services, the private sector, Wildlife department, and the Botswana University of Agriculture and Natural Resources. There are also veterinarians in each of the 10 Department of Veterinary Services districts, and at some of the sub-districts. Para-veterinarians have helped increase veterinary coverage in more remote geographies and support rural farmers, who rely on veterinary services from the public sector. There is an emerging private veterinary sector in wealthier urban areas.

As of 2019, DVS had made substantial investments in personnel, though many trained staff would often leave. Availability of in-service training for veterinarians and para-veterinarians is strong, including for more specialist positions, such as meat inspection. There is a need to expand the workforce of specialists, especially for food security and biosafety. Previously there was a Field Epidemiology Training Program (FETP), which the Ministry of Health and Wellness conducted in collaboration with the U.S. CDC. It ran for only two cycles and could not continue mainly due to lack of funding, though it may be re-launched.

DISEASE MANAGEMENT

Surveillance and Reporting

Human disease surveillance is predominantly indicator based. The Ministry of Health and Wellness coordinates the IDSR public health surveillance program that includes four zoonotic diseases: human rabies (including rabies exposure), acute hemorrhagic fever syndrome, yellow fever and plague. This is reported at least weekly through IDSR.

DVS conducts surveillance for seven zoonotic diseases (avian influenza, rabies, brucellosis, bovine tuberculosis, cysticercosis, Rift Valley fever, anthrax). Animal disease surveillance is paper-based. Once collected, surveillance data is entered into the Botswana Animal Information and Traceability System (BAITS) and the Data Management Query and Reporting System.

Through the DVS' Epidemiology Unit, disease surveillance plans have been developed for several priority diseases, including for both active and passive surveillance, which are then implemented by District Veterinary officers. The Botswana National Veterinary Laboratory (BNVL) submits a summary of the testing results to DVS' Disease Control Division and SILAB (the veterinary laboratory information management system).

Passive animal disease surveillance occurs between the DVS Extension Office and livestock keepers. DVS' Disease Control Division and its Epidemiology Unit works closely with BNVL to shape disease surveillance plans. These reflect aspects of risk analyses in relation to sampling in high-risk targeted surveillance areas, live animal imports, and buffalo following incursions. In terms of wildlife surveillance, active surveillance is conducted in African buffaloes for FMD in northern Botswana. DWNP and DVS also collaborate during HPAI outbreaks.

Surveillance data are not routinely shared between the MoHW and DVS. According to the JEE (2017), there is limited exchange of information prior to formal reports being put forth by the animal health sector to WOA, a finding reinforced in the PVS Follow-Up Evaluation (2019) report. The JEE also reported that there was no strategy for multisectoral responses to zoonotic disease outbreaks.

Regular surveillance for AMR has not yet been carried out in the country. Every year the department implements risk-based sampling and testing of animals and animal products and feed for residues and prohibited substances and antibiotics. In regard to human health, laboratory capacity exists at the National Health Laboratory to conduct antimicrobial

susceptibility testing, but such activities are not being conducted.

Access to Diagnostics and Vaccines

Diagnostics

For human samples, each district health management team has one laboratory. Specimens can be referred from one level to another, depending on the suspected causative organism which the sample may contain. For animal samples, the laboratory network is composed of BNVL and two satellite laboratories launched in 2018 (in Jwaneng and Maun). BNVL has ten laboratories which operate at BSL-2+. The Virology laboratory was intended to be BSL-3, but does not meet the minimum standard. For highly pathogenic or high security pathogens, BNVL relies on other labs, like Botswana Vaccine Institute (BVI). BVI is the WOAHA reference laboratory for FMD, and BNVL for contagious bovine pleuropneumonia (CBPP). OVI in South Africa, Seibersdorf in Vienna, and the Animal and Plant Health Agency in the UK are also used. BNVL has multiplex PCR capabilities, but relies on outside reference laboratories for sequencing. Data from BNVL is linked with the DVS Epidemiology Unit through a laboratory information management system. MoHW also uses a laboratory information system.

Vaccination

There is in-country vaccine production for FMD and PPR at BVI. BVI also supplies vaccines regionally. Vaccination campaigns for FMD are well-organized. The government supports vaccinations for other priority diseases (Newcastle, rabies); some are routine or in response to an outbreak. Geographically, rabies vaccination is conducted all over the country.

PREVENTION AND CONTROL MEASURES

Animal cordon fences are a key tool in DVS' disease prevention and control arsenal. Fences divide the country into differing risk zones - "red zones" in the north (Ngamiland) and "green zones" in the south.

Ngamiland's fencing separates it into different disease control and protection zones. The zones have evolved over time based on FMD outbreaks and requirements from the European Union. Additionally, a buffalo fence surrounds the perimeter of the Okavango Delta to prevent interactions between buffalo and cattle. A significant portion of DVS' budget and labor goes towards fence maintenance. More recently, DVS and other stakeholders are seeking more effective and cheaper alternatives.

DVS also carries out national vaccination programs for various diseases including FMD, anthrax, black leg and rabies annually. Livestock keepers are alerted to vaccination programs and vaccination schedules through local staff visits, radio and television, social media, and phone and text messaging.

In terms of AMR, a situational analysis and the 2017-2022 National Action Plan (NAP) were both conducted and drafted in 2017. The NAP outlines activities for surveillance, including of priority pathogens, infection prevention and control, and antimicrobial stewardship. However, the NAP has not been endorsed by government. It is not clear to what progress has been made beyond the draft stage. A key indicator of success will be making surveillance of pathogens, including via susceptibility testing, routine in the country.

ETHICS

Animal research guidelines outline the terms, conditions and procedures for institutions or individuals who wish to conduct research in the country under the auspices of the Ministry of Environment, Natural Resources Conservation and Tourism. According to the Ministry's research guidelines, the welfare and ethical considerations section mentions that "any applicant whose proposed activities involve animal and/or human subjects shall submit proof of clearance by an Institutional Animal Care and Use Committee (IACUC) and/or Institutional Review Board (IRB)."

BOTSWANA CASE STUDY:

Foot and Mouth Disease (FMD)

CURRENT STATUS

Botswana's experience with foot and mouth disease (FMD) outbreaks and control extends back to the 1930s. Neighboring countries Zimbabwe, Zambia, South Africa, Namibia, have also reported the disease in their respective countries. Funding for FMD prevention and control is a significant portion of the DVS budget. Sporadic outbreaks have occurred in vaccinated zones, resulting in the Government spending more than P129 million (\$9.6 million) on FMD control from 2009/2010 through 2013/2014. After nearly two years without FMD outbreaks, there was a recurrence of the disease in the north in 2017. Vaccination, movement controls, and strict adherence to biosecurity measures brought the outbreak under control and WOAHA declared it FMD free without vaccination.

HIGH-LEVEL STRATEGIES

Botswana operates an extensive network of veterinary cordon fences, quarantine camps, disease surveillance, and vaccination. It uses a zoning system that demarcates protected and controlled areas for FMD, separating “red zones” in the north (Ngamiland) and “green zones” in the south. The FMD Control Strategy was reviewed in 2021, with the support of the EU. New WOAHA policies on FMD control now focus on disease prevalence in meat, rather than livestock-wildlife separation. This has the potential to shift reliance on fencing to alternative risk mitigation measures, such as herding and kraaling. Policy reforms are underway in Botswana, including new draft guidelines for FMD control aimed at accessing previously restricted beef markets.²¹

SURVEILLANCE

The Botswana Animal Identification and Traceability System (BAITS) registers livestock keepers and their animals in order for them to be eligible for the European Union (EU) Market. Animals are identified individually in the system to allow their traceability. The system is also

used to issue import and export permits. It is in the process of being upgraded to enable registration of communal areas, allow farmers to capture data offline, and capture abattoir licensing and holdings audits in the system.

The objective is to assess herd immunity level in cattle or small stock vaccinated against FMD in vaccination zones, to gauge the effectiveness of the vaccination programs, and assess the viral/disease activity in both vaccinated and FMD free zones. The surveillance targets high risk areas that are prone to FMD incursion and the general FMD free zones. High risk areas include areas along international borders, interfaces of livestock areas and national parks (with buffaloes) and in free zones bordering FMD vaccination areas. The target species are cloven-hoofed animals susceptible to FMD, and specifically cattle and small-stock. To a smaller degree, buffaloes that are destroyed in the process of the deployment of this plan are sampled where possible.

In FMD free zones, buffalo incursion triggers surveillance on all crushes where cloven hoofed livestock may have had interactions with the buffalo.

Surveillance in cattle and other small stock is also conducted in randomly selected crushes within 10 km of the FMD free zone bordering with high risk zones or countries. In FMD free zones without vaccination, surveillance is carried out twice a year in randomly selected crushes. All cloven hoofed livestock (cattle, small-stock and pigs) imported from FMD free countries or zones are required to be offloaded and visually inspected upon arrival in addition to other Livestock Identification Traceback System requirements. Botswana has 24 border inspection posts, of which 6 are approved for live animal imports/export while another 10 are approved for small animals, horses and animal products as they lack facilities for FMD control (offloading and holding). Four international airports have facilities for small animal import/export. All premises within a 10 km intensive surveillance zone bordering FMD infected zones are excluded from slaughter for the EU. An active surveillance programme is also applied to African buffaloes in northern Botswana.

PREVENTION AND CONTROL

The key strategies for prevention and control include fencing and vaccination. Ngamiland is cordoned by 10,000 km of fence that place it into different disease control and protection zones. In addition, buffalo fencing is used along the Okavango Delta perimeter to prevent cattle-buffalo encounters. This consists of a double cordon fence which has been upgraded over time to maintain its effectiveness. However, fence maintenance is an on-going activity across all the districts in the north. In particular, repair is overwhelmed by destruction of fences by elephants. In the recent past, Botswana experienced drought which led to unprecedented movement of wildlife, especially elephants, that trampled on the fences on their way such that resources allocated for fence maintenance could not cope with the damage.

Maintenance of this expanse of fences is an enormous challenge to the DVS manpower and financial resources. Normal inter-sector fences are not able to withstand elephant movements. Buffalo fences provide greater resistance but require daily repair.

The zoning system of Botswana is regularly audited by the EU since Botswana exports beef to the EU from the “green” zone. These audits aim to carefully inspect the fencing system in Ngamiland to ensure that north-south cattle movement is strictly regulated and buffalo-cattle contact is prevented. However, the overall approach to fencing is being reconsidered; a “reduce, restructure and realign” policy is now being pursued to provide livestock producers in Ngamiland better incentives for beef production and enable wildlife movement along corridors.

Vaccination is done three times a year at an interval of four months. Within the “red” zone there are over 4,000 crush pens where cattle can be gathered for FMD vaccinations which are carried out twice a year; in high-risk areas (around the national parks) three vaccinations are applied. Post-vaccination sero-monitoring is also carried out to evaluate the effectiveness of vaccination. Vaccine is manufactured locally. FMD vaccination is a costly exercise. The programme has been sustained for decades because there is political will and financial support from government.

IMPLEMENTATION GAPS

- Maintenance of accreditation requires skilled, committed and highly motivated personnel, which is the status required by Trading partners — hence the need to invest in capacity building
- Ways to fully engage stakeholders in planning and implementation of the program

BOTSWANA CASE STUDY:

FMD

KEY RECOMMENDATIONS

- Develop a recurrent budget line item specifically for compensation payments due to animal disease losses not declared emergencies
- Increase participatory approaches including the involvement of communities in animal diseases surveillance planning and implementation
- DVS should generate a priority list of needs it may have in animal health in which other government entities could be of assistance and consider formalizing cooperation through agreements (e.g. memoranda of collaboration) with key government counterparts



- Livestock-focused agriculture sector, relating to climatic conditions and tradition, but severe droughts are leading to declining meat exports
- High reliance on the diamond industry, with the mining sector linked to a third of government revenue and funding for social development
- High biodiversity, particularly in the Okavango Delta, but climate change is threatening several crucial ecosystems and their linked social factors
- High mobility of livestock and herders for water
- Wildlife migration needs are challenging the historical reliance on veterinary cordon fencing to reduce transboundary animal disease transmission
- Reliance on South Africa's economy and imports, affecting domestic food security
- Wildlife poaching and trade is a persistent issue; anti-poaching efforts depend on external resources and face limited resources, staffing and uneven geographic scope

South Africa



Completed Assessments and Plans

JEE	PVS Evaluation	PVS Evaluation Follow-Up	PVS Gap Analysis	PVS Legislation	IHR-PVS Bridging Workshop	NAPHS	OHZDP	National AMR Action Plan	NBSAP
2017	2012	-	2014	-	-	2018	2016	2018	2016

Indicator **Country** **Region Average** **Continent Average**

Coordination and Financing

Multi-sector and One Health collaboration/coordination for AMR (1-5)	4.00	3.00	2.44
Collaborative effort on activities to address zoonoses (0-100)	60.00	48.00	54.23
Current health expenditure per capita (USD)	546.69	368.75	132.25
CFE disbursements (USD)	395,791.00	295,395.50	4,903,032.44

Workforce

Veterinarians (total)	4,451.00	1,522.00	3,512.00
Veterinarians (per 1,000 people)	0.08	0.39	0.17
Public animal health professionals (total)	135.00	59.00	461.00
Public animal health professionals (per 1,000 people)	0.00	0.02	0.02
Medical doctors (total)	46,393.00	9,993.00	8,574.00
Medical doctors (per 1,000 people)	0.79	0.50	0.41
Up-to-date multisectoral workforce strategy (1-5)	2.00	1.80	2.19
Progress with strengthening veterinary services (1-5)	4.00	4.00	2.80

Demographic Factors

Population (total)	58,558,267.00	13,325,978.80	24,185,802.76
Population growth (% , 2010-2019)	14.30	12.44	23.73
GNI per capita (USD)	6,670.00	4,864.00	2,525.37

Environmental and Sanitation Factors

Land area (sq km)	1,213,090.00	530,134.00	548,414.71
Arable land (% land area)	9.89	7.13	14.14
Forest area (% land area)	14.09	15.87	27.57
Terrestrial protected areas (% land area)	8.34	15.98	16.27
Average primary forest loss (ha)	687.29	687.29	20,326.14
Access to basic drinking water — rural (%)	80.70	69.02	55.48
Access to basic drinking water — national (%)	92.70	80.62	69.76
Access to basic hygiene — national (%)	44.00	28.70	26.71
Access to basic sanitation — national (%)	75.70	57.74	40.71

Animal Factors

Average livestock stocks (LSUs)	14,431,763.60	3,654,307.56	5,551,123.37
Average livestock exports (LSUs)	74,490.00	43,602.71	33,314.93
Average livestock imports (LSUs)	208,048.30	64,740.74	31,044.50
Mammal species (number)	375.00	220.60	241.65

STATUS OF ONE HEALTH AND VETERINARY SYSTEMS

In 2014, the National Department of Health (NDoH) established South Africa's National One Health Forum (OHF) as a collaborative government-led initiative to identify, advise, and monitor mechanisms required to comply with the International Health Regulations (IHR) for detecting and responding to zoonotic events in South Africa (Box - National One Health Forum). Ten members of the OHF are elected to the One Health Steering Committee, with at least one representative from the NDoH; the Department of Agriculture, Land Reform, and Rural Development (DALRRD); and the Department of Forestry, Fisheries and Environment (DFFE). As of April 2022, it is co-chaired by representatives from Onderstepoort Veterinary Research (OVR) and the National Institute for Communicable Diseases (NICD). Formal decisions are made via the NOHSC.

The OHF, under the guidance of the Steering Committee, has drafted a Framework for Implementation of the One Health Approach in South Africa in 2020 with supporting bills, the International Health Regulations Bill and the National Public Health Institute of South Africa Bill. The approval of these policies was held over awaiting the One Health High-Level Expert Panel's (OHHLEP) definition of One Health. Current efforts are exploring how South Africa will implement the forthcoming Global One Health Joint Plan of Action.

Several cross-agency and cross-departmental initiatives exist outside of the OHF. The Multi-Sectoral National Outbreak Response Team (MNORT) is led by NDoH, and includes DALRRD, NICD, and the Department of Trade and Industry, among other stakeholders. NDoH also oversees the AMR strategy led by the Ministerial Advisory Committee on AMR in addition to the National Health Operations Centre,

Box. Objectives of South Africa's National One Health Forum

- To foster collaboration and strengthen dialogue between One Health stakeholders in South Africa.
- To identify priority areas for action along the One Health theme.
- To identify and catalogue existing surveillance programs, identify challenges and gaps, and advise on the way forward in the Country.
- To identify research gaps and challenges to relevant research concerning priority areas in One Health in the Country.
- To identify training needs in the Country for all One Health stakeholders associated with priority areas.
- Aligning and informing the One Health activities and role players with the Global Health Security Action Package for Zoonotic Diseases.

which is responsible for coordinating responses to public health emergencies. There is also a National Joint Operational and Intelligence Structure, which is the national coordinating body responding to all major incidents in South Africa. The Ministerial Technical Committee Veterinary Working Group is the interdepartmental technical working group between the national and provincial departments of agriculture that advises on veterinary issues. DFFE also hosts the Multi-Sectoral Project Steering Committee, which is working on developing an environment sector response plan to zoonotic diseases led by DFFE.

In 2006, the National Animal Health Forum (NAHF) was established as a liaison between veterinarians, animal production groups, and the government to discuss

SWOT ANALYSIS | SOUTH AFRICA

S

STRENGTHS

Existing One Health collaboration platforms (National One Health Steering Committee; Disease-specific advisory Groups; Coordinating structures)

Access to external funding streams

Ongoing efforts to adapt veterinary curriculum

Highly skilled human resources (e.g. Animal Health Technicians)

Several universities have entomology training and research capacity

Robust public and private sector surveillance and diagnostic capacities

Multisectoral reporting of One Health surveillance data

Capacity to manufacture animal vaccines

Preparedness and response policies and plans in place; trained and tested outbreak response team

Active One Health research activities

Laboratory quality assurance support provided to other nations

W

WEAKNESSES

No national One Health MoU or Strategic Plan

Limited sectoral and director-level engagement and buy-in in One Health

No specific One Health budget-line items and limited financial capacity

Lack of cooperation in risk reduction plans and policies

Staffing challenges, especially in rural areas

Lack of coordination amongst groups conducting One Health research

Limited engagement of private sector in surveillance, except for controlled and notifiable diseases

Lack of real-time surveillance data collection and analysis

Siloed animal and human surveillance

OBP vaccine manufacturing is severely constrained due to facility capacity

OBP monopoly on certain animal vaccines precludes timely and sufficient production

Asymmetry in vaccine production and importation/registration to meet needs

O

OPPORTUNITIES

New FMD policies and approach to cordon • Proposal in place for establishing high-level central One Health governance structure

Proposed establishment of a One Health capability by the Defence Force to identify research needs related to biological threats

Agreement and interest between academic faculties to develop collaborative One Health hub

Development of Institute for Preparedness and Prevention of Pandemics by Department of Science and Innovation

Progress made on a framework to integrate biodiversity considerations in land-use planning via SANBI

Engaging private sector professionals and laboratories in disease surveillance

T

THREATS

System overwhelmed with disease outbreaks (e.g. Rabies, FMD, African Swine Fever and Avian Influenza)

Emigration of veterinarians, and difficulty of hosting international veterinarians

Training for veterinarians to meet rising and new demands of commercial, companion, and wildlife sectors

Decline in government research and diagnostic capacity

One Health training seen as primarily a veterinary responsibility

Box.
**Key institutions within NDoH,
DALLRD, and DFFE**

National Health Laboratory Service (NHLS) — The largest human diagnostic pathology service in South Africa, with the responsibility of supporting the national and provincial health departments.

National Institute for Communicable Diseases (NICD) — A division of NHLS, NICD is the national public health institute of South Africa. It provides reference microbiology, virology, epidemiology, surveillance and public health research and training to support the government's response to communicable disease threats. The NICD assists in the planning of policies and programs to support communicable disease control and elimination efforts and provides numerous specialized diagnostic services. A critical role of the NICD is to respond to outbreaks through the Outbreak Response Unit and the Emergency Operations Centre.

Agricultural Research Council (ARC) — Conducts fundamental and applied research with partners to generate knowledge, develop human capital and foster innovation in agriculture through the development and transfer of technology, and the dissemination and commercialization of research results.

Onderstepoort Biological Products (OBP) — Ensures financial viability to sustain the strategic capabilities in manufacturing veterinary vaccines to prevent and control animal diseases that have an impact on food security, human health, and livelihoods.

South African Veterinary Council (SAVC) — Registers and regulates all veterinarians and veterinary paraprofessionals, sets the minimum standards of practice and the standards of training for all the said professions, requires continuing education to maintain registration and applies discipline and penalties if necessary.

South African National Biodiversity Institute (SANBI) — Leads biodiversity management and research agenda and its One Health research program has prioritized monitoring pathogens and diseases vectors (ticks, mosquitos, and snails) in wild animals and mapping shifting distribution. The South African government is the primary source of funding for biodiversity management. Substantial progress has been made in developing a framework for incorporating biodiversity considerations into decision-making and land use planning, with various tools under development to achieve this (e.g. list of threatened ecosystems concerning the Biodiversity Act; provincial spatial biodiversity plans and bioregional plans which identify critical biodiversity areas based on systematic biodiversity planning techniques).

animal disease control matters and currently involves DALRRD, the Provincial Agricultural Departments, and other national departments. The goal of the NAHF is public-private partnerships to improve veterinary services and compliance with animal health standards. The NAHF, together with DALRRD, established various Steering Committees such as the Brucellosis Steering Committee at the end of July 2016, the Rabies Action Group, and the FMD Steering Committee.

Through the South African Military Health Service, under the Defence Force the Military Veterinary Institute has a broad remit, managing the health of military working dogs, horses and wildlife on military training areas and contributing in limited disease monitoring in support of Force Health Protection.

At the time of the JEE Mission (2017), the OHF was also in the process of developing a formal One Health policy for South Africa that was anticipated to encourage complete stakeholder participation. Although open to any interested party, only three departments are currently represented. The level of departmental representation in the OHF is at a low level (e.g. Deputy-Director). Departmental representatives, although representing the department, often have very limited knowledge of other sections within that department. Navigating complex department communication channels to ascertain this additional knowledge can delay decision-making. Voting rights are currently limited to three departments. OHF has very limited decision-making powers.

One Health Coordination

Through the One Health Forum/One Health Steering Committee efforts are underway to develop and approve a Framework for Implementation of the One Health Approach in South Africa. If approved, it will commit the government at the strategic level. The Department of Science and Innovation working in partnership with the National Research Foundation intends to establish an Institute for the Preparedness and Prevention of Pandemics. The Institute will essentially devise response plans against potential

future disease outbreaks of epidemic and pandemic proportions to avoid the issues that affected the population in the current COVID-19 pandemic.

There is no dedicated funding or budget for IHR. A budget line is available for routine activities, while supplementary funds are released for the management of emergencies. The effectiveness of these funding opportunities has been proven during several events, for example, the country's support to countries in West Africa during the Ebola Virus Disease epidemic in 2014–2015, including with skilled laboratory and epidemiological functions. External donor support is mostly for climate change and wildlife trade. The OHF has very limited funding and human resources because it is seen as an over and above function.

Training Pipelines

The South Africa Field Epidemiology Training Program, a collaboration involving the National Department of Health, NICD, National Laboratory Service, and U.S. CDC, was launched in 2006. Operating as a two-year program, it can lead to a masters in public health from two South African universities. The program is a member of AFENET, promoting international knowledge and capacity exchange.

The University of Pretoria hosts South Africa's only Faculty of Veterinary Science. It offers an undergraduate veterinary degree program (BVSc), a nursing program (BVetNurs), and postgraduate degrees (MMedVet, MSc, PhD). Para-veterinary professionals or animal health technicians can obtain their qualification at the University of Southern Africa (UNISA) or the Tsolo Agriculture and Rural Development Institute (TARDI) (both conferring a Diploma in Animal Health) or North-West University (Diploma in Animal Health; BSc Agric (Animal Health)). Veterinary technologists are trained at Tshwane University of Technology (BHSc in Veterinary Technology). Animal Welfare Assistants are trained by the UNISA. There is currently no prescribed qualification for laboratory animal technologists. Under the South African Military Health Service, training pathways are in place to support

Box.

One Health academic initiatives and projects

Hans Hoheisen Wildlife Research Station (HHWRS) — A field-based research facility within the Foot and Mouth Disease and Tuberculosis control zone to develop solutions to One Health challenges, through the Mnisi Community Programme is followed.

Mnisi Community Programme (MCP) — A multidisciplinary platform for research, teaching, learning and engagement in collaboration with the Mnisi community, their animals, and surrounding conservation areas. Research is mainly focused on disease ecology and emergence, zoonoses, livestock production and trade as well as natural resource utilization. Various governmental institutions and departments as well as faculties and departments within the University of Pretoria form part of the network of stakeholders involved in the MCP. These include the Department of Animal and Wildlife Sciences at UP, Mpumalanga Veterinary Services within the Mpumalanga Department of Agriculture, as well as the Mpumalanga Tourism and Parks Agency.

University of Witwatersrand Rural Facility (WRF) — Serves as a base for rural-focused research, student training, and community outreach in Limpopo close to the Kruger National Park and the border with Mpumalanga Province. WRF is thus an important base for ecological research on the facility and in surrounding communal rangelands, and private and state conservation areas.

Empowering universities' Learning and Research Capacities in the one Health Approach for the Management of animals at the wildlife, livestock, and human interface in South Africa (ELEPHANT) — The Erasmus+ Capacity Building in higher education project has developed a consortium of 6 South African and 2 Europe Union institutions to share expertise and apply a transversal multidisciplinary approach to strengthen One Health research capacity, with a focus on disease and pollutant surveys, prevention and intervention/control and a reduction in the wildlife-livestock conflicts.

Sustainable Business through Training for Veterinary Paraprofessionals (VPP) — A pilot project aimed at improving Veterinary Para-Professional capacity to deliver essential animal health services in key geographies to help reduce animal mortality and increase the productivity of livestock assets for smallholder livestock keepers sponsored by The European Commission for the Control of FMD, FAO, HealthforAnimals, and the World Veterinary Association.

attainment of health degrees, including the BVSc and BVetNurs.

Most universities, especially those that present health training modules, have an entomology capability with high-quality entomology research.

There is a One Health Platform at the University of Pretoria. It consists of an institutional platform that supports research, teaching, and learning and continuing professional development in One Health at undergraduate and postgraduate levels, and the Hans Hoheisen Wildlife Research Station. The Faculty of Veterinary Science also run a collaborative Master's degree in Global One Health with the Institute of Tropical Medicine from Antwerp, Belgium. They also have an undergraduate module in conjunction with the Faculty of Health Science at the University of Pretoria aimed at training future veterinarians on One Health. It is envisaged to further extend this programme to the University of the Witwatersrand, Wits Rural Facility in the same area.

The University of Pretoria also hosts the Future Africa Campus, aimed at facilitating leadership in transdisciplinary research. Over 100 Research Fellows have been selected from 10 countries, spanning all five of Africa's regions. Future Africa co-hosted the 2022 Sustainability Research and Innovation conference with the global sustainability research and policy platform Future Earth.

In 1997, the government approved the concept of a one-year Compulsory Community Service (CCS) to address the shortage of essential scarce skills in many rural areas. The national Veterinary Services funds one year of compulsory community service for new veterinary graduates. The Primary Animal Health Care and Compulsory Service programs aim to reach all production systems and connect them with veterinarians. It focuses on three areas: (i) ensuring that all animals are covered by national official AH programs, (ii) ensuring that all farmers have regular contact with veterinarians to benefit from relevant and adapted private services, and (iii) ensuring that the farmers

referred to as the non-commercial farmers receive an adequate extension or public awareness about animal health and veterinary public health. This program has successfully been implemented since 2014, but unfortunately has not contributed to the retention of veterinarians in South Africa. On the contrary, many CCS veterinarians are disillusioned with the state of veterinary services in South Africa and opt to emigrate. A pilot mentorship program launched in 2020 has been successful at increasing participation in CCS.

The current veterinarians' national field network allows animal production systems limited access to private veterinary services, including clinical services. Private veterinarians were in regular contact with animals and farmers only in the commercial sector, which represents less than 5% of farmers (households rearing animals) and only 60% of cattle and 80% of small ruminants. The CCS system was an attempt to address this shortcoming and to allow access to veterinary services in the non-commercial, small scale, and rural farming communities.

Since 2022, veterinarians are no longer considered to be a critical scarce skill in South Africa, which makes it exceedingly difficult for foreigners to obtain a work visa. South Africa only has one veterinary school and its capacity at the first-year level is limited to roughly 200 veterinarians, with ~150 qualifying after 6 years. This barely replaces the number of veterinarians that retire, emigrate or change careers - this set against a backdrop of an increasing companion, production and wildlife animal population. Over the past few years, the country experienced an upsurge in demand for veterinary services among small scale farmers and declining funding in the agriculture sector. A high demand from overseas for South African veterinary skills has also reduced retention of veterinary professionals within the country. It is evident that, if there is not a current shortage, there will be one in the very near future.

There is inadequate innovation in the training and skilling of veterinarians and para-veterinary professionals in some emerging and critical veterinary competence areas by academic training institutions.

The expanding requirement of “Day 1 Competencies,” the curriculum content as well as the sophistication of veterinary and para-veterinary professionals’ training needs make it increasingly difficult within the allocated time, to train a person with the required scope of skills and knowledge to address the specified needs in a single program as is currently structured. Day 1 Competencies are of a high standard in the fields identified. However, the scope of competencies needs to be redefined to be in line with the natural progression of disease and the concomitant prevention/health care strategies. Too much emphasis is placed on skills and competencies relating to health care (primary, secondary and tertiary) instead of preventive measures starting with primordial prevention. There should thus be a reappraisal of competencies and skills to ensure the whole continuum of health management is covered.

To date, the respective academic institutions have either not been able to provide post-graduate training for some specialized services, or market opportunities optimally. Challenges of financing for tertiary education and creating sustainable career paths for veterinary and para-veterinary professionals amidst rising demand for veterinary services are well noted. This is notable in the animal welfare and meat inspection sector, such as

among Animal Welfare Assistants and Animal Health Technicians. Students are unable to find practicum opportunities that are required to graduate, and employment once they graduate. To address the oversupply of Animal Health Technicians, it is now being considered whether or not to allow them to open their own practices to provide Primary Health Care for compensation. This would leave a huge void in preventive programs (e.g. extension services).

Efforts have been made to address several of the workforce challenges outlined by the National South Africa Veterinary Strategy (2016-2026). There has been an increase in the number of training institutions aimed at training para-veterinary professionals. A curriculum redesign in the Veterinary faculty was launched to train professionals to address the diverse needs of the livestock sector and of government.

The majority of veterinarians registered with the South African Veterinary Council (SAVC) are in private practice, largely in urban small animal practice. The precise number of practicing veterinarians in South Africa is poorly documented, as some emigrate (permanently or temporarily) but may retain their registration. Similarly, veterinarians may have opted into non-veterinary careers but opted to retain their registration. As of March 2021, there were 3,483 veterinarians and 212 veterinary specialists registered with the SAVC.



- Highly biodiverse, including nine biomes
- Major focus on agricultural production for exports, but domestic food shortages remain
- Reliable access to water is limiting factor for local food production
- Environmental degradation occurring outside of protected areas, particularly from large-scale mining
- Keeping of livestock near protected areas (e.g. Limpopo) allows for wildlife-livestock spillover
- Since 2015, experienced a multi-year drought and water shortages followed by severe floods
- Challenges with access to safe food of animal origin

DISEASE MANAGEMENT

Surveillance and Reporting

Rigorous active surveillance programs are in place for a few prioritized diseases (e.g. Brucellosis, Tuberculosis, African Horse Sickness, Avian Influenza and Newcastle Disease, Bovine Spongiform Encephalopathy, and pig diseases). Indicator based-surveillance and event-based surveillance are well established in South Africa. There are no specific detailed passive surveillance procedures and programs for any prioritized disease. There are gaps for certain disease in terms of standardization and data quality to inform decision-making (Box on Brucellosis surveillance).

Zoonotic diseases have been carefully prioritized and several are officially legislated as notifiable to both human and animal health authorities. All veterinarians are obligated to report on all notifiable diseases, whereas human healthcare providers are required to report on certain zoonoses and other important medical conditions to the local authorities, who in turn report them to the district, provincial, and national levels. However, there are no legal provisions requiring laboratories to notify the authorities when communicable diseases are detected.

NDoH, DALRRD, and DFFE coordinate on data sharing and activities. At the technical leadership level, the MNORT is the key mechanism for coordinated zoonotic disease information sharing, analysis, and action. Although there is yet to be a joint electronic real-time reporting system, close to real-time cross-sectoral reporting happens where necessary (such as for rabies). Updated zoonotic disease reporting is provided at monthly MNORT meetings by both human and animal health staff, providing the opportunity for joint discussion and analysis of zoonotic risks and trends and related risk management and/or response measures. The South African Public Health Emergency Operations Center is located at the National Institute of Communicable Diseases and receives data to conduct regular event-based surveillance.

Box. Challenge to Brucellosis Surveillance

Brucellosis is the model disease for the National Veterinary Strategy. A standard detailed Brucellosis database format is not utilized across all provinces and reporting from the provinces varies in quality and consistency. The current national disease reporting system database does not contain adequate variables to monitor and evaluate necessary trends. Additionally, accurate cattle census data is lacking in most areas and provinces, which makes it difficult to calculate the true prevalence of brucellosis and conduct accurate surveillance. It is further exacerbated by the fact that humans and animal laboratories, both of whom must earn certification under the South African National Accreditation System (SANAS), are limited to testing in most cases only human and or animal samples, limiting the potential interpretation of results through a One Health lens.

Due to the lack in real-time information and the lag in information sharing, some private initiatives, such as the disease reporting system of the NGO RuVASA (the Ruminant Veterinary Association of South Africa), have been launched to serve the farming communities, wholly dependent on real-time, accurate information for herd management. RuVASA collects and distributes monthly disease reports from members of RuVASA, DALRRD, and the wider animal health community via the National Animal Health Forum.

Disease surveillance and detection is mainly done by governmental institutions. Although South Africa has a wide distribution of private veterinarians and private animal and human laboratories, they are not optimally utilized. Passive surveillance and early detection are implemented mainly through the field network of public animal health technician sub-offices and by private

veterinarians (without official delegation). Passive surveillance and early detection could be improved by creating a network of veterinarians in both the public and private sectors working in the field, under the authority of the Veterinary Services, that regularly visit farms and animals. Private veterinarians primarily service the commercial livestock sector and have limited official functions apart from passive surveillance, sampling relating to movement permits, and delivering compulsory rabies vaccination for pets.

There is a strong supply of animal health technicians in South Africa, currently exceeding available job prospects. However, the lack of human resources in

preventive care operations specifically, be it a deficiency in numbers, a deficiency in occupied positions, or a deficiency in the scope of positions, hampers proper disease surveillance and detection, witnessed by the recent FMD outbreaks across the country. This is further compounded by the lack of financial and logistical resources for those that are still employed by the state to function optimally. Workforce development efforts are under way with FAO to explore how the scope of practice for animal health technicians, building on their strong supply in the country, can contribute to primary care to better support preventive efforts.

Box.
AMR in South Africa

There is a Ministerial Advisory Committee on AMR within NDoH, which includes other departments such as DALRRD, Trade and Industry, Science and Technology, and Education. There is a National Antimicrobial Resistance Strategy Framework 2018-2024 which is framed in a One Health approach and, as of 2017, a national plan for animal health surveillance and testing of AMR was in development.

There are policies on the use of medically important antimicrobials in livestock production and care. Other antimicrobials are also scheduled under the Medicines Act 101 of 1965 managed by the NDoH and require a veterinary prescription or being dispensed directly by veterinarians.

As of 2017, there were plans to develop integrated electronic data exchange between human, animal and environmental sources of AMR pathogens (e.g. typing) in the future. However, there is no such programme for pathogen surveillance in animal health, with only ad hoc clinical reports of AMR by public and private field veterinarians. In the draft plan for national veterinary surveillance, a farm-to-retail approach will be implemented in phases, with some farms and abattoirs used as sentinel sites.

The National AMR reference laboratory is housed at NICD, reinforced as well by several state and private laboratory centres able to test and report AMR using the Clinical and Laboratory Standards Institute guidelines. GERMS-SA, a network of public and private clinical microbiology laboratories in South Africa, has formed an active laboratory-based surveillance program. The veterinary laboratory capacity to undertake AMR detection and reporting is currently lacking in government laboratories. Private and academic laboratories have AMR capacities.

Access to Diagnostics and Vaccines

Diagnostics

South Africa has an advanced laboratory system with 10 national, 17 provincial, 42 regional, and over 150 district laboratories, as well as three large private laboratories and a BSL-4 laboratory. NICD houses BSL-3 laboratories and is one of only two high-containment BSL-4 laboratories in Africa. NHLS consists of more than 270 sites representing around 80 percent of pathology data in the country. South Africa provides support for proficiency testing—a component of quality assurance programs in laboratories—to over 10 countries in Africa.

Provincial veterinary laboratories undertake relevant diagnostic functions tailored to provincial priorities and programs such as for bovine tuberculosis and brucellosis surveillance, and suspect controlled/notifiable disease post-mortems. Satellite laboratories from provincial laboratories provide basic diagnostic services.

The Onderstepoort Veterinary Research (OVR) is a national reference laboratory. It lies outside the Veterinary Services structure under the para-statal, Agricultural Research Council, with DALRRD providing annual funding and approvals for official diagnostic functions. OVR is accredited by the World Organisation for Animal Health (WOAH) as a reference diagnostic centre for several animal disease-causing agents. It is the collaborating center for WOAH's surveillance and control of animal disease in Africa and the FAO's emergency preparedness for transboundary animal diseases for Africa. This status, however, is at risk of being lost because the diagnostic and research capacity has been steadily declining, due to a number of complex factors (financial, human resources, pressure from outbreaks, etc.). The decline in the research and diagnostic capacity at OVR, ARC and Government, in general, is a source of serious concern to the livestock industry.

The Sequencing Core Facility at the NICD conducts next-generation sequencing for diagnosis and outbreak support. Several NICD laboratories are World Health

Organization (WHO) collaborating partners, providing reference diagnostic services and surveillance for communicable diseases such as influenza, poliomyelitis, tuberculosis, and measles, among others. Surveillance for malaria and arbovirus vectors is a key function of the NICD, which also houses five insectaries for culturing a wide range of mosquito species that are of public health importance.

Vaccines

OVR produces vaccines against FMD, and tick-borne diseases through its subsidiary, Onderstepoort Biological Products (OBP), a state-owned entity. OBP produces veterinary vaccines for livestock protection against bacterial and viral diseases. Apart from vaccines, OBP produces a range of diagnostic reagents for use by the veterinary laboratories to assist in diagnosing a range of livestock diseases. Updates are currently planned to the facility, to support modernization and adoption of new technologies.

OBP's capacity to provide these vaccines, many of them for which the OBP holds the patent rights, is currently limited. It creates a huge vacuum that lends itself to locally and independently produced compounded or autogenous vaccines from other suppliers, which are not validated for efficacy and can lead to the further spread of disease. The capacity to produce vaccines of strategic importance quickly and in sufficient volumes needs to be addressed.

PREVENTION AND CONTROL MEASURES

Vaccination campaigns take place for FMD, Anthrax, Brucellosis and Rabies and are a provincialized function, supported with government funds. Implementation differs between provinces. There are compulsory vaccination activities to control FMD, corridor disease, TB, and brucellosis risks from domestic buffalo movements. All dogs and cats must be vaccinated against rabies, all poultry vaccinated against Newcastle Disease, and all horses vaccinated against African Horse Sickness.

A Rabies Working Group is in place with the participation of NDoH, DALRRD, NICD, Amayeza Info Services, and the University of Pretoria. The Working Group utilized a One Health approach in the development of their updated guidelines for the Prevention of Rabies in Humans, released in September 2021. The guidelines include a list of confirmed cases in wild and domestic animal species and their distribution in the country, as well as clinical presentation (reflecting animal behaviour) by species and information on broader bat lyssaviruses detected in the country. This information is helping to improve understanding of the epidemiology of rabies in South Africa and inform earlier detection and is reflected in the clinical protocols outlined in the guidelines.

The lack of human and logistical resources is a key limitation to implementing and sustaining disease control activities, especially for rabies. These types of campaigns require a long-term and ongoing commitment by government to fund and support the necessary human and logistical requirements needed to carry out these campaigns well beyond the apparent disappearance of the disease. Turnover of professionals, particularly in rural areas, is high. This either means they are unexposed to training or, if they do receive training, that institutional knowledge is lost with their departure.

For WOAH-Listed, but non state-controlled diseases such as Rift Valley fever (RVF), vaccination is not compulsory. During prior RVF outbreak periods, Veterinary Services has provided no-cost vaccination to communal and smallholder farmers in affected regions. OBP is also a supplier of RVF vaccines to other countries in eastern and southern Africa. Challenges in matching supply and demand have been reported in prior years, particularly with inconsistent demand in non-outbreak years that may make production need challenging to predict.

In recent years, monitoring of conditions predictive for RVF risk have allowed for early warning alerts to be issued to livestock stakeholders by the government, which could ultimately help to inform production needs earlier. A long-term research study (10 years), supported by DTRA, involving five national agencies and provincial and private sector partners is conducting RVF monitoring in livestock, humans, and mosquitos, with an early warning system under development. Based on information from remote sensing, risk alerts have been proactively issued by the government during high-rainfall years to encourage prevention and early detection.

ETHICS

The ethical review of animal care and use for scientific purposes in South Africa, as well as oversight of animal care and welfare, is performed by institutional Animal Ethics Committees and is regulated by legislation as well as by national standards, “South African National Standard (SANS) for the Care and Use of Animals for Scientific Purposes (SANS 10386)”. The National Council of Societies for the Prevention of Cruelty to Animals is represented on most of these committees. The Livestock Welfare Coordinating Committee has been operating for the past 40 years and includes the Industry, Universities, Government, and welfare organizations. They promote the welfare of livestock by participating in the drafting of informative material for all farmers, livestock transporters, abattoirs, sale yards, vending sites, and show-ground operators. The South African Veterinary Association (SAVA) has an Animal Ethics and Welfare committee that addresses challenges in the field of animal ethics and welfare from a veterinary perspective.

SOUTH AFRICA CASE STUDY:

Early Warning Systems

CURRENT STATUS

The value of early warning systems has been recognized in the management of disease threats such as Rift Valley fever virus. The Eastern Cape province of South Africa, which has the highest number of livestock of any South African province, developed a specialized animal health unit, the Early Warning Unit, that would serve as a central provincial Coordinating Centre in all cases of animal disease outbreaks, prevention and control. It was established with capacities for response, knowledge management, community engagement and social facilitation, and emergency stockpiles (e.g. a Rapid Response facility).

However, since 1997, support from South Africa's Veterinary Services has declined, affecting the Unit functionality, including its infrastructure (physical and operational knowledge, institutional memory), funding, and personnel (management, morale). This decline has been evidenced in the limited capacity of the unit to respond to the recent and ongoing rabies outbreak in the Gqeberha area. In this outbreak, there were no structures to coordinate general strategic outbreak response and mobilization (especially personnel) or communicate the outbreak to top management, internal staff, and the public. The available information, Contingency plans and standard operating procedures (SOPs) were not activated.

HIGH-LEVEL STRATEGIES

All components of this Center are still in place, but need to be re-activated and strengthened. The centre has a twinning relationship with the Lower Saxony State Office for Consumer Protection and Food Safety (LAVES) and the Veterinary University Hannover (TiHo) in Germany. This unique Centre, if reactivated, could be in the forefront of facilitating the fight against existing and re-emerging animal diseases outbreaks and act as a model for other Provinces to emulate.

SURVEILLANCE

The surveillance component is managed by a Deputy Director who is conversant with epidemiological information technology (IT) and data trend analysis packages. Through its Knowledge Management unit, the Center is capable of doing the following: coordinate active surveillance; carry out passive surveillance; analysis of diseases outbreak data; epidemiological analysis; production of reports; mapping of vaccination and other control activities and disease outbreaks; production of disease information sheets as soon as alerted about any outbreak; and processing of environmental, weather, climate daily reports and alerts.

PREVENTION AND CONTROL

To support risk management, the Centre's functions, among others, are: fiscal planning; personnel planning; spatial planning and social policy; response/diseases outbreak mitigation models; impact assessments; risk analysis; cost-benefit studies; risk acceptability; community education and social facilitation. Having these under one umbrella creates the potential for coordination and integration of multi-sectoral input.

SOUTHERN AFRICA CASE STUDY:

Early Warning Systems

IMPLEMENTATION GAPS

The infrastructure and some key staff are in place, but currently suffers from:

- Weak support at a higher level
- Limited understanding of the importance of such a structure by the current State Veterinary Management in the province in animal disease outbreaks
- Lack of dedicated staff with knowledge in disease surveillance and control methodologies
- Insufficient funding, including to sustain routine and emergency operations
- Lack of a liaison function with other institutions working in the same area for information flow and coherence

KEY RECOMMENDATIONS

A Private-Public Partnership has been proposed between the Province, the South African Veterinary Association, and National Animal Health Forum. This Unit would then maintain its initial mandates, namely in an Ongoing role: a core permanent “peace time” role of the unit to carry out day-to-day activities focusing on Early Warning and Preparedness/Readiness; and in Emergencies (during disease outbreaks): becoming the nucleus of decision-making (i.e., a war council role). The main components of the Unit would be: Knowledge Management; Early diseases outbreak warning systems; Veterinary Informatic and Veterinary Information Archiving (active information storage); Mobilization; Rapid Response (the Existing Rapid Response Facility); and Veterinary Outreach Programmes. Specific activities for each component to optimize the function of the Centre are discussed below.

The Early Disease outbreak warning component:

- Provide management information in respect to possible disease occurrences/outbreaks and required best practices for effective professional prevention as well as required interventions in cases of exotic disease outbreaks.
- Monitor trends (not limited to epidemic prone diseases only) and identify potential hazards for both communicable and economic diseases
- Analyze all available data using both statistical methods and epidemiological specialist knowledge
- Issue Alerts, Warnings, Watches and Advisories (currently on Weather and Climate) to staff and the public
- Advise on required epidemiological disease investigations
- Advise on necessary risk management and risk communication
- Evaluate provincial disease eradication and control campaigns
- Monitor and evaluate effectiveness of ongoing surveillance
- Identify and advise on disease control related preparedness targets
- Establish systems to set and continuously evaluate “people/behavior related” critical success factors
- Report on all findings regularly to decision makers

Veterinary Informatics and Information Archiving components:

- Coordinate the creation and maintenance of an integrated, functional, effective and efficient veterinary information management system (across all fields in the State Veterinary Services: Animal Health, Veterinary Public Health, Laboratory, Exports, Animal Disease Surveillance Unit/Early Warning)
- Coordinate an E-VET network in the Directorate
- Provide an integrated system for data entry, analysis and automated standard reports and special data examination
- Drive the process to transform raw data into information and knowledge, ensuring organizational memory and capacitation
- Ensure data quality and integrity
- Enable effective information dissemination, internally within Government organizations and externally with the public and other stakeholders
- Identify suitable technologies to overcome the physical challenges of communication limitations
- Offer applicable mobile solutions (e.g., for outbreak situations, field staff)
- Coordinate collection, capture and collation of data, including maintaining databases
- Integrate spatial functionality and analysis in the system
- Ensure timely (ideally real-time) data transfer and processing

Veterinary Outreach component:

- In routine activities, facilitate a veterinary Extension system: Educate communities in various animal diseases; Facilitate and support farmers days; and Produce disease audio-visual materials (e.g. videos, pictures, and flyers)
- During emergencies, provide a receptive environment for the outbreak control teams: Make the community aware of the outbreak; Prime the community of the expected control activities; and Communicate the recovery activities.

Rapid Response Facility:

- Store equipment and materials to support disease control activities within the first 72 hours of an animal disease outbreak
- Act as a staging center for the Outbreak exercise
- Act as a supply management center to facilitate purchasing and distribution of the required materials during the campaign
- Act as a closing out center at the close of the campaign

With thanks to Prof. Dr. Ivan Lwanga-Iga

SOUTHERN AFRICA ENDNOTES

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Annex: Additional Country Dashboards

Algeria

Completed Assessments and Plans

JEE	PVS Evaluation	PVS Evaluation Follow-Up	PVS Gap Analysis	PVS Legislation	IHR-PVS Bridging Workshop	NAPHS	OHZDP	National AMR Action Plan	NBSAP
-	2007	2012	2013	-	-	-	-	-	2016

Indicator **Country** **Region Average** **Continent Average**

Coordination and Financing

Multi-sector and One Health collaboration/coordination for AMR (1-5)	—	3.25	2.44
Collaborative effort on activities to address zoonoses (0-100)	80.00	80.00	54.23
Current health expenditure per capita (USD)	248.21	193.69	132.25
CFE disbursements (USD)	0.00	1,177,816.00	4,903,032.44

Workforce

Veterinarians (total)	16,399.00	16,338.00	3,512.00
Veterinarians (per 1,000 people)	0.39	0.32	0.17
Public animal health professionals (total)	1,349.00	2,884.00	461.00
Public animal health professionals (per 1,000 people)	0.03	0.06	0.02
Medical doctors (total)	72,604.00	35,477.00	8,574.00
Medical doctors (per 1,000 people)	1.72	1.14	0.41
Up-to-date multisectoral workforce strategy (1-5)	—	2.75	2.19
Progress with strengthening veterinary services (1-5)	—	2.75	2.80

Demographic Factors

Population (total)	43,053,054.00	40,199,717.83	24,185,802.76
Population growth (% , 2010-2019)	19.70	16.18	23.73
GNI per capita (USD)	4,010.00	3,648.33	2,525.37

Environmental and Sanitation Factors

Land area (sq km)	2,381,741.00	1,264,604.12	548,414.71
Arable land (% land area)	3.15	8.55	14.14
Forest area (% land area)	0.81	4.73	27.57
Terrestrial protected areas (% land area)	7.50	10.30	16.27
Average primary forest loss (ha)	—	—	20,326.14
Access to basic drinking water — rural (%)	88.70	80.02	55.48
Access to basic drinking water — national (%)	93.60	89.08	69.76
Access to basic hygiene — national (%)	83.70	68.90	26.71
Access to basic sanitation — national (%)	87.60	79.56	40.71

Animal Factors

Average livestock stocks (LSUs)	6,106,485.34	8,526,466.35	5,551,123.37
Average livestock exports (LSUs)	11.00	62,432.79	33,314.93
Average livestock imports (LSUs)	98,892.92	74,599.46	31,044.50
Mammal species (number)	205.00	219.17	241.65

Angola

Completed Assessments and Plans

JEE	PVS Evaluation	PVS Evaluation Follow-Up	PVS Gap Analysis	PVS Legislation	IHR-PVS Bridging Workshop	NAPHS	OHZDP	National AMR Action Plan	NBSAP
2019	2012	-	2014	2016	-	2021	-	-	2020

Indicator **Country** **Region Average** **Continent Average**

Coordination and Financing

Collaborative effort on activities to address zoonoses (0-100)	100.00	42.22	54.23
Current health expenditure per capita (USD)	71.33	93.32	132.25
CFE disbursements (USD)	40,000.00	14,066,100.14	4,903,032.44
Multi-sector and One Health collaboration/coordination for AMR (1-5)	0.00	2.00	2.44

Workforce

Veterinarians (total)	682.00	1,238.00	3,512.00
Veterinarians (per 1,000 people)	0.02	0.09	0.17
Public animal health professionals (total)	44.00	130.00	461.00
Public animal health professionals (per 1,000 people)	0.00	0.01	0.02
Medical doctors (total)	6,593.00	5,013.00	8,574.00
Medical doctors (per 1,000 people)	0.21	0.28	0.41
Up-to-date multisectoral workforce strategy (1-5)	2.00	2.12	2.19
Progress with strengthening veterinary services (1-5)	0.00	2.00	2.80

Demographic Factors

Population (total)	31,825,299.00	19,367,603.00	24,185,802.76
Population growth (% ,2010-2019)	36.30	29.12	23.73
GNI per capita (USD)	2,970.00	2,607.78	2,525.37

Environmental and Sanitation Factors

Land area (sq km)	1,246,700.00	721,868.89	548,414.71
Arable land (% land area)	3.93	4.51	14.14
Forest area (% land area)	53.87	54.50	27.57
Terrestrial protected areas (% land area)	6.97	20.20	16.27
Average primary forest loss (ha)	9,108.95	68,938.35	20,326.14
Access to basic drinking water — rural (%)	27.40	40.91	55.48
Access to basic drinking water — national (%)	55.80	63.26	69.76
Access to basic hygiene — national (%)	26.70	22.62	26.71
Access to basic sanitation — national (%)	49.90	36.84	40.71

Animal Factors

Average livestock stocks (LSUs)	3,855,197.24	4,183,733.13	5,551,123.37
Average livestock exports (LSUs)	3.05	8,818.17	33,314.93
Average livestock imports (LSUs)	13,496.29	9,067.12	31,044.50
Mammal species (number)	390.00	291.00	241.65

Benin

Completed Assessments and Plans

JEE	PVS Evaluation	PVS Evaluation Follow-Up	PVS Gap Analysis	PVS Legislation	IHR-PVS Bridging Workshop	NAPHS	OHZDP	National AMR Action Plan	NBSAP
2017	2007	2013	2008	2008	2019	2019	-	-	2016

Indicator **Country** **Region Average** **Continent Average**

Coordination and Financing

Multi-sector and One Health collaboration/coordination for AMR (1-5)	2.00	2.20	2.44
Collaborative effort on activities to address zoonoses (0-100)	20.00	55.00	54.23
Current health expenditure per capita (USD)	29.13	58.69	132.25
CFE disbursements (USD)	0.00	2,361,848.00	4,903,032.44

Workforce

Veterinarians (total)	864.00	909.00	3,512.00
Veterinarians (per 1,000 people)	0.08	0.08	0.17
Public animal health professionals (total)	18.00	52.00	461.00
Public animal health professionals (per 1,000 people)	0.00	0.01	0.02
Medical doctors (total)	763.00	5,967.00	8,574.00
Medical doctors (per 1,000 people)	0.06	0.17	0.41
Up-to-date multisectoral workforce strategy (1-5)	2.00	2.03	2.19
Progress with strengthening veterinary services (1-5)	3.00	2.80	2.80

Demographic Factors

Population (total)	11,801,151.00	24,464,630.38	24,185,802.76
Population growth (% ,2010-2019)	28.30	27.01	23.73
GNI per capita (USD)	1,250.00	1,335.62	2,525.37

Environmental and Sanitation Factors

Land area (sq km)	112,760.00	378,979.38	548,414.71
Arable land (% land area)	24.83	19.19	14.14
Forest area (% land area)	28.25	27.66	27.57
Terrestrial protected areas (% land area)	29.60	15.52	16.27
Average primary forest loss (ha)	2.48	6,105.65	20,326.14
Access to basic drinking water — rural (%)	58.20	56.77	55.48
Access to basic drinking water — national (%)	66.40	69.53	69.76
Access to basic hygiene — national (%)	11.00	21.94	26.71
Access to basic sanitation — national (%)	16.50	30.23	40.71

Animal Factors

Average livestock stocks (LSUs)	1,673,786.63	4,615,777.30	5,551,123.37
Average livestock exports (LSUs)	30.25	20,487.72	33,314.93
Average livestock imports (LSUs)	12,956.76	36,990.70	31,044.50
Mammal species (number)	240.00	230.06	241.65

Burkina Faso

Completed Assessments and Plans

JEE	PVS Evaluation	PVS Evaluation Follow-Up	PVS Gap Analysis	PVS Legislation	IHR-PVS Bridging Workshop	NAPHS	OHZDP	National AMR Action Plan	NBSAP
2017	2008	-	2009	2010	-	2018	2017	2018	2011

Indicator **Country** **Region Average** **Continent Average**

Coordination and Financing

Multi-sector and One Health collaboration/coordination for AMR (1-5)	2.00	2.20	2.44
Collaborative effort on activities to address zoonoses (0-100)	80.00	55.00	54.23
Current health expenditure per capita (USD)	42.34	58.69	132.25
CFE disbursements (USD)	329,319.00	2,361,848.00	4,903,032.44

Workforce

Veterinarians (total)	3,308.00	909.00	3,512.00
Veterinarians (per 1,000 people)	0.17	0.08	0.17
Public animal health professionals (total)	67.00	52.00	461.00
Public animal health professionals (per 1,000 people)	0.00	0.01	0.02
Medical doctors (total)	1,910.00	5,967.00	8,574.00
Medical doctors (per 1,000 people)	0.09	0.17	0.41
Up-to-date multisectoral workforce strategy (1-5)	2.00	2.03	2.19
Progress with strengthening veterinary services (1-5)	2.00	2.80	2.80

Demographic Factors

Population (total)	20,321,383.00	24,464,630.38	24,185,802.76
Population growth (% , 2010-2019)	30.20	27.01	23.73
GNI per capita (USD)	770.00	1,335.62	2,525.37

Environmental and Sanitation Factors

Land area (sq km)	273,600.00	378,979.38	548,414.71
Arable land (% land area)	21.93	19.19	14.14
Forest area (% land area)	22.90	27.66	27.57
Terrestrial protected areas (% land area)	14.89	15.52	16.27
Average primary forest loss (ha)	—	6,105.65	20,326.14
Access to basic drinking water — rural (%)	35.00	56.77	55.48
Access to basic drinking water — national (%)	47.90	69.53	69.76
Access to basic hygiene — national (%)	11.90	21.94	26.71
Access to basic sanitation — national (%)	19.40	30.23	40.71

Animal Factors

Average livestock stocks (LSUs)	7,819,696.73	4,615,777.30	5,551,123.37
Average livestock exports (LSUs)	29,433.58	20,487.72	33,314.93
Average livestock imports (LSUs)	5,911.46	36,990.70	31,044.50
Mammal species (number)	188.00	230.06	241.65

Burundi

Completed Assessments and Plans

JEE	PVS Evaluation	PVS Evaluation Follow-Up	PVS Gap Analysis	PVS Legislation	IHR-PVS Bridging Workshop	NAPHS	OHZDP	National AMR Action Plan	NBSAP
2018	2007	2019	2012	2012	-	2018	-	-	2015

Indicator **Country** **Region Average** **Continent Average**

Coordination and Financing

Multi-sector and One Health collaboration/coordination for AMR (1-5)	2.00	2.25	2.44
Collaborative effort on activities to address zoonoses (0-100)	60.00	54.12	54.23
Current health expenditure per capita (USD)	20.57	130.86	132.25
CFE disbursements (USD)	778,830.00	1,742,137.45	4,903,032.44

Workforce

Veterinarians (total)	1,976.00	3,097.00	3,512.00
Veterinarians (per 1,000 people)	0.18	0.16	0.17
Public animal health professionals (total)	11.00	212.00	461.00
Public animal health professionals (per 1,000 people)	0.00	0.01	0.02
Medical doctors (total)	1,084.00	3,311.00	8,574.00
Medical doctors (per 1,000 people)	0.10	0.42	0.41
Up-to-date multisectoral workforce strategy (1-5)	2.00	2.33	2.19
Progress with strengthening veterinary services (1-5)	1.00	2.62	2.80

Demographic Factors

Population (total)	11,530,577.00	24,025,701.94	24,185,802.76
Population growth (% , 2010-2019)	32.90	23.76	23.73
GNI per capita (USD)	240.00	2,517.78	2,525.37

Environmental and Sanitation Factors

Land area (sq km)	25,680.00	378,644.97	548,414.71
Arable land (% land area)	46.73	18.53	14.14
Forest area (% land area)	10.89	24.89	27.57
Terrestrial protected areas (% land area)	7.59	17.04	16.27
Average primary forest loss (ha)	18.90	6,271.69	20,326.14
Access to basic drinking water – rural (%)	56.60	49.58	55.48
Access to basic drinking water – national (%)	60.80	63.02	69.76
Access to basic hygiene – national (%)	6.10	18.18	26.71
Access to basic sanitation – national (%)	45.80	35.66	40.71

Animal Factors

Average livestock stocks (LSUs)	852,544.39	6,601,349.50	5,551,123.37
Average livestock exports (LSUs)	10.29	44,401.60	33,314.93
Average livestock imports (LSUs)	1,410.61	12,869.29	31,044.50
Mammal species (number)	203.00	240.61	241.65

Cabo Verde

Completed Assessments and Plans

JEE	PVS Evaluation	PVS Evaluation Follow-Up	PVS Gap Analysis	PVS Legislation	IHR-PVS Bridging Workshop	NAPHS	OHZDP	National AMR Action Plan	NBSAP
2019	2014	-	-	-	-	-	-	-	2016

Indicator **Country** **Region Average** **Continent Average**

Coordination and Financing

Multi-sector and One Health collaboration/coordination for AMR (1-5)	—	2.20	2.44
Collaborative effort on activities to address zoonoses (0-100)	177.89	58.69	132.25
Current health expenditure per capita (USD)	40.00	55.00	54.23
CFE disbursements (USD)	0.00	2,361,848.00	4,903,032.44

Workforce

Veterinarians (total)	53.00	909.00	3,512.00
Veterinarians (per 1,000 people)	0.10	0.08	0.17
Public animal health professionals (total)	14.00	52.00	461.00
Public animal health professionals (per 1,000 people)	0.03	0.01	0.02
Medical doctors (total)	452.00	5,967.00	8,574.00
Medical doctors (per 1,000 people)	0.83	0.17	0.41
Up-to-date multisectoral workforce strategy (1-5)	2.00	2.03	2.19
Progress with strengthening veterinary services (1-5)	—	2.80	2.80

Demographic Factors

Population (total)	549,936.00	24,464,630.38	24,185,802.76
Population growth (% , 2010-2019)	11.60	27.01	23.73
GNI per capita (USD)	3,630.00	1,335.62	2,525.37

Environmental and Sanitation Factors

Land area (sq km)	4,030.00	378,979.38	548,414.71
Arable land (% land area)	12.41	19.19	14.14
Forest area (% land area)	11.27	27.66	27.57
Terrestrial protected areas (% land area)	2.90	15.52	16.27
Average primary forest loss (ha)	—	6,105.65	20,326.14
Access to basic drinking water — rural (%)	75.80	56.77	55.48
Access to basic drinking water — national (%)	87.10	69.53	69.76
Access to basic hygiene — national (%)	—	21.94	26.71
Access to basic sanitation — national (%)	73.90	30.23	40.71

Animal Factors

Average livestock stocks (LSUs)	58,749.47	4,615,777.30	5,551,123.37
Average livestock exports (LSUs)	0.00	20,487.72	33,314.93
Average livestock imports (LSUs)	1,628.42	36,990.70	31,044.50
Mammal species (number)	31.00	230.06	241.65

Central African Republic

Completed Assessments and Plans

JEE	PVS Evaluation	PVS Evaluation Follow-Up	PVS Gap Analysis	PVS Legislation	IHR-PVS Bridging Workshop	NAPHS	OHZDP	National AMR Action Plan	NBSAP
2019	2010	-	-	-	-	2021	-	-	-

Indicator **Country** **Region Average** **Continent Average**

Coordination and Financing

Multi-sector and One Health collaboration/coordination for AMR (1-5)	–	2.00	2.44
Collaborative effort on activities to address zoonoses (0-100)	20.00	42.22	54.23
Current health expenditure per capita (USD)	37.20	93.32	132.25
CFE disbursements (USD)	360,867.00	14,066,100.14	4,903,032.44

Workforce

Veterinarians (total)	259.00	1,238.00	3,512.00
Veterinarians (per 1,000 people)	0.06	0.09	0.17
Public animal health professionals (total)	30.00	130.00	461.00
Public animal health professionals (per 1,000 people)	0.01	0.01	0.02
Medical doctors (total)	335.00	5,013.00	8,574.00
Medical doctors (per 1,000 people)	0.07	0.28	0.41
Up-to-date multisectoral workforce strategy (1-5)	1.00	2.12	2.19
Progress with strengthening veterinary services (1-5)	–	2.00	2.80

Demographic Factors

Population (total)	4,745,179.00	19,367,603.00	24,185,802.76
Population growth (% , 2010-2019)	8.20	29.12	23.73
GNI per capita (USD)	520.00	2,607.78	2,525.37

Environmental and Sanitation Factors

Land area (sq km)	622,980.00	721,868.89	548,414.71
Arable land (% land area)	2.89	4.51	14.14
Forest area (% land area)	35.85	54.50	27.57
Terrestrial protected areas (% land area)	18.06	20.20	16.27
Average primary forest loss (ha)	10,675.44	68,938.35	20,326.14
Access to basic drinking water – rural (%)	NA	40.91	55.48
Access to basic drinking water – national (%)	NA	63.26	69.76
Access to basic hygiene – national (%)	–	22.62	26.71
Access to basic sanitation – national (%)	NA	36.84	40.71

Animal Factors

Average livestock stocks (LSUs)	3,135,355.00	4,183,733.13	5,551,123.37
Average livestock exports (LSUs)	26,650.00	8,818.17	33,314.93
Average livestock imports (LSUs)	5,072.00	9,067.12	31,044.50
Mammal species (number)	302.00	291.00	241.65

Chad

Completed Assessments and Plans

JEE	PVS Evaluation	PVS Evaluation Follow-Up	PVS Gap Analysis	PVS Legislation	IHR-PVS Bridging Workshop	NAPHS	OHZDP	National AMR Action Plan	NBSAP
2017	2008	2013	2014	2016	2018	2018	-	-	-

Indicator **Country** **Region Average** **Continent Average**

Coordination and Financing

Multi-sector and One Health collaboration/coordination for AMR (1-5)	—	2.00	2.44
Collaborative effort on activities to address zoonoses (0-100)	40.00	42.22	54.23
Current health expenditure per capita (USD)	29.85	93.32	132.25
CFE disbursements (USD)	100,000.00	14,066,100.14	4,903,032.44

Workforce

Veterinarians (total)	868.00	1,238.00	3,512.00
Veterinarians (per 1,000 people)	0.06	0.09	0.17
Public animal health professionals (total)	200.00	130.00	461.00
Public animal health professionals (per 1,000 people)	0.01	0.01	0.02
Medical doctors (total)	859.00	5,013.00	8,574.00
Medical doctors (per 1,000 people)	0.05	0.28	0.41
Up-to-date multisectoral workforce strategy (1-5)	2.00	2.12	2.19
Progress with strengthening veterinary services (1-5)	—	2.00	2.80

Demographic Factors

Population (total)	15,946,882.00	19,367,603.00	24,185,802.76
Population growth (% , 2010-2019)	33.40	29.12	23.73
GNI per capita (USD)	700.00	2,607.78	2,525.37

Environmental and Sanitation Factors

Land area (sq km)	1,259,200.00	721,868.89	548,414.71
Arable land (% land area)	4.13	4.51	14.14
Forest area (% land area)	3.51	54.50	27.57
Terrestrial protected areas (% land area)	20.35	20.20	16.27
Average primary forest loss (ha)	—	68,938.35	20,326.14
Access to basic drinking water — rural (%)	29.50	40.91	55.48
Access to basic drinking water — national (%)	38.70	63.26	69.76
Access to basic hygiene — national (%)	5.80	22.62	26.71
Access to basic sanitation — national (%)	8.30	36.84	40.71

Animal Factors

Average livestock stocks (LSUs)	24,266,861.90	4,183,733.13	5,551,123.37
Average livestock exports (LSUs)	48,906.30	8,818.17	33,314.93
Average livestock imports (LSUs)	856.97	9,067.12	31,044.50
Mammal species (number)	210.00	291.00	241.65

Comoros

Completed Assessments and Plans

JEE	PVS Evaluation	PVS Evaluation Follow-Up	PVS Gap Analysis	PVS Legislation	IHR-PVS Bridging Workshop	NAPHS	OHZDP	National AMR Action Plan	NBSAP
2017	2011	-	2016	2014	-	2018	-	-	2016

Indicator **Country** **Region Average** **Continent Average**

Coordination and Financing

Multi-sector and One Health collaboration/coordination for AMR (1-5)	–	2.25	2.44
Collaborative effort on activities to address zoonoses (0-100)	60.00	54.12	54.23
Current health expenditure per capita (USD)	72.32	130.86	132.25
CFE disbursements (USD)	50,000.00	1,742,137.45	4,903,032.44

Workforce

Veterinarians (total)	29.00	3,097.00	3,512.00
Veterinarians (per 1,000 people)	0.04	0.16	0.17
Public animal health professionals (total)	2.00	212.00	461.00
Public animal health professionals (per 1,000 people)	0.00	0.01	0.02
Medical doctors (total)	220.00	3,311.00	8,574.00
Medical doctors (per 1,000 people)	0.26	0.42	0.41
Up-to-date multisectoral workforce strategy (1-5)	3.00	2.33	2.19
Progress with strengthening veterinary services (1-5)	–	2.62	2.80

Demographic Factors

Population (total)	850,891.00	24,025,701.94	24,185,802.76
Population growth (% , 2010-2019)	23.40	23.76	23.73
GNI per capita (USD)	1,380.00	2,517.78	2,525.37

Environmental and Sanitation Factors

Land area (sq km)	1,861.00	378,644.97	548,414.71
Arable land (% land area)	35.46	18.53	14.14
Forest area (% land area)	17.93	24.89	27.57
Terrestrial protected areas (% land area)	10.15	17.04	16.27
Average primary forest loss (ha)	32.88	6,271.69	20,326.14
Access to basic drinking water – rural (%)	76.90	49.58	55.48
Access to basic drinking water – national (%)	80.20	63.02	69.76
Access to basic hygiene – national (%)	–	18.18	26.71
Access to basic sanitation – national (%)	35.90	35.66	40.71

Animal Factors

Average livestock stocks (LSUs)	45,083.51	6,601,349.50	5,551,123.37
Average livestock exports (LSUs)	4.98	44,401.60	33,314.93
Average livestock imports (LSUs)	963.54	12,869.29	31,044.50
Mammal species (number)	42.00	240.61	241.65

Congo

Completed Assessments and Plans

JEE	PVS Evaluation	PVS Evaluation Follow-Up	PVS Gap Analysis	PVS Legislation	IHR-PVS Bridging Workshop	NAPHS	OHZDP	National AMR Action Plan	NBSAP
2019	2019	-	-	-	-	-	-	2022	2015

Indicator **Country** **Region Average** **Continent Average**

Coordination and Financing

Multi-sector and One Health collaboration/coordination for AMR (1-5)	–	2.00	2.44
Collaborative effort on activities to address zoonoses (0-100)	20.00	42.22	54.23
Current health expenditure per capita (USD)	48.56	93.32	132.25
CFE disbursements (USD)	50,000.00	14,066,100.14	4,903,032.44

Workforce

Veterinarians (total)	304.00	1,238.00	3,512.00
Veterinarians (per 1,000 people)	0.06	0.09	0.17
Public animal health professionals (total)	40.00	130.00	461.00
Public animal health professionals (per 1,000 people)	0.01	0.01	0.02
Medical doctors (total)	544.00	5,013.00	8,574.00
Medical doctors (per 1,000 people)	0.10	0.28	0.41
Up-to-date multisectoral workforce strategy (1-5)	2.00	2.12	2.19
Progress with strengthening veterinary services (1-5)	–	2.00	2.80

Demographic Factors

Population (total)	5,380,504.00	19,367,603.00	24,185,802.76
Population growth (% ,2010-2019)	25.90	29.12	23.73
GNI per capita (USD)	1,810.00	2,607.78	2,525.37

Environmental and Sanitation Factors

Land area (sq km)	341,500.00	721,868.89	548,414.71
Arable land (% land area)	1.61	4.51	14.14
Forest area (% land area)	64.31	54.50	27.57
Terrestrial protected areas (% land area)	40.74	20.20	16.27
Average primary forest loss (ha)	25,117.34	68,938.35	20,326.14
Access to basic drinking water – rural (%)	45.70	40.91	55.48
Access to basic drinking water – national (%)	73.20	63.26	69.76
Access to basic hygiene – national (%)	48.00	22.62	26.71
Access to basic sanitation – national (%)	20.20	36.84	40.71

Animal Factors

Average livestock stocks (LSUs)	267,294.00	4,183,733.13	5,551,123.37
Average livestock exports (LSUs)	2,315.00	8,818.17	33,314.93
Average livestock imports (LSUs)	1,465.80	9,067.12	31,044.50
Mammal species (number)	257.00	291.00	241.65

Democratic Republic of the Congo

Completed Assessments and Plans

JEE	PVS Evaluation	PVS Evaluation Follow-Up	PVS Gap Analysis	PVS Legislation	IHR-PVS Bridging Workshop	NAPHS	OHZDP	National AMR Action Plan	NBSAP
2018	2007	-	2011	-	-	2022, 2019	2016	-	2016

Indicator **Country** **Region Average** **Continent Average**

Coordination and Financing

Multi-sector and One Health collaboration/coordination for AMR (1-5)	2.00	2.00	2.44
Collaborative effort on activities to address zoonoses (0-100)	60.00	42.22	54.23
Current health expenditure per capita (USD)	20.57	93.32	132.25
CFE disbursements (USD)	97,030,452.00	14,066,100.14	4,903,032.44

Workforce

Veterinarians (total)	4,401.00	1,238.00	3,512.00
Veterinarians (per 1,000 people)	0.05	0.09	0.17
Public animal health professionals (total)	530.00	130.00	461.00
Public animal health professionals (per 1,000 people)	0.01	0.01	0.02
Medical doctors (total)	31,546.00	5,013.00	8,574.00
Medical doctors (per 1,000 people)	0.38	0.28	0.41
Up-to-date multisectoral workforce strategy (1-5)	3.00	2.12	2.19
Progress with strengthening veterinary services (1-5)	2.00	2.00	2.80

Demographic Factors

Population (total)	86,790,568.00	19,367,603.00	24,185,802.76
Population growth (% ,2010-2019)	34.40	29.12	23.73
GNI per capita (USD)	530.00	2,607.78	2,525.37

Environmental and Sanitation Factors

Land area (sq km)	2,267,050.00	721,868.89	548,414.71
Arable land (% land area)	5.21	4.51	14.14
Forest area (% land area)	56.13	54.50	27.57
Terrestrial protected areas (% land area)	13.83	20.20	16.27
Average primary forest loss (ha)	366,634.99	68,938.35	20,326.14
Access to basic drinking water – rural (%)	22.80	40.91	55.48
Access to basic drinking water – national (%)	43.20	63.26	69.76
Access to basic hygiene – national (%)	4.50	22.62	26.71
Access to basic sanitation – national (%)	20.50	36.84	40.71

Animal Factors

Average livestock stocks (LSUs)	1,381,534.16	4,183,733.13	5,551,123.37
Average livestock exports (LSUs)	74.01	8,818.17	33,314.93
Average livestock imports (LSUs)	21,851.39	9,067.12	31,044.50
Mammal species (number)	566.00	291.00	241.65

Egypt

Completed Assessments and Plans

JEE	PVS Evaluation	PVS Evaluation Follow-Up	PVS Gap Analysis	PVS Legislation	IHR-PVS Bridging Workshop	NAPHS	OHZDP	National AMR Action Plan	NBSAP
-	2009	-	2010	-	-	-	-	2018	2016

Indicator **Country** **Region Average** **Continent Average**

Coordination and Financing

Multi-sector and One Health collaboration/coordination for AMR (1-5)	—	3.25	2.44
Collaborative effort on activities to address zoonoses (0-100)	—	80.00	54.23
Current health expenditure per capita (USD)	149.84	193.69	132.25
CFE disbursements (USD)	0.00	1,177,816.00	4,903,032.44

Workforce

Veterinarians (total)	63,000.00	16,338.00	3,512.00
Veterinarians (per 1,000 people)	0.63	0.32	0.17
Public animal health professionals (total)	13,201.00	2,884.00	461.00
Public animal health professionals (per 1,000 people)	0.13	0.06	0.02
Medical doctors (total)	74,923.00	35,477.00	8,574.00
Medical doctors (per 1,000 people)	0.75	1.14	0.41
Up-to-date multisectoral workforce strategy (1-5)	—	2.75	2.19
Progress with strengthening veterinary services (1-5)	—	2.75	2.80

Demographic Factors

Population (total)	100,388,076.00	40,199,717.83	24,185,802.76
Population growth (% , 2010-2019)	21.30	16.18	23.73
GNI per capita (USD)	2,690.00	3,648.33	2,525.37

Environmental and Sanitation Factors

Land area (sq km)	995,450.00	1,264,604.12	548,414.71
Arable land (% land area)	2.92	8.55	14.14
Forest area (% land area)	0.05	4.73	27.57
Terrestrial protected areas (% land area)	13.14	10.30	16.27
Average primary forest loss (ha)	—	—	20,326.14
Access to basic drinking water — rural (%)	98.80	80.02	55.48
Access to basic drinking water — national (%)	99.00	89.08	69.76
Access to basic hygiene — national (%)	89.80	68.90	26.71
Access to basic sanitation — national (%)	94.20	79.56	40.71

Animal Factors

Average livestock stocks (LSUs)	8,382,171.59	8,526,466.35	5,551,123.37
Average livestock exports (LSUs)	7,612.86	62,432.79	33,314.93
Average livestock imports (LSUs)	121,433.23	74,599.46	31,044.50
Mammal species (number)	214.00	219.17	241.65

Equatorial Guinea

Completed Assessments and Plans

JEE	PVS Evaluation	PVS Evaluation Follow-Up	PVS Gap Analysis	PVS Legislation	IHR-PVS Bridging Workshop	NAPHS	OHZDP	National AMR Action Plan	NBSAP
-	2010	-	-	-	-	-	-	-	2015

Indicator **Country** **Region Average** **Continent Average**

Coordination and Financing

Multi-sector and One Health collaboration/coordination for AMR (1-5)	—	2.00	2.44
Collaborative effort on activities to address zoonoses (0-100)	20.00	42.22	54.23
Current health expenditure per capita (USD)	254.89	93.32	132.25
CFE disbursements (USD)	0.00	14,066,100.14	4,903,032.44

Workforce

Veterinarians (total)	32.00	1,238.00	3,512.00
Veterinarians (per 1,000 people)	0.03	0.09	0.17
Public animal health professionals (total)	NA	130.00	461.00
Public animal health professionals (per 1,000 people)	NA	0.01	0.02
Medical doctors (total)	507.00	5,013.00	8,574.00
Medical doctors (per 1,000 people)	0.40	0.28	0.41
Up-to-date multisectoral workforce strategy (1-5)	—	2.12	2.19
Progress with strengthening veterinary services (1-5)	—	2.00	2.80

Demographic Factors

Population (total)	1,355,982.00	19,367,603.00	24,185,802.76
Population growth (% , 2010-2019)	43.70	29.12	23.73
GNI per capita (USD)	6,280.00	2,607.78	2,525.37

Environmental and Sanitation Factors

Land area (sq km)	28,050.00	721,868.89	548,414.71
Arable land (% land area)	4.28	4.51	14.14
Forest area (% land area)	87.59	54.50	27.57
Terrestrial protected areas (% land area)	19.27	20.20	16.27
Average primary forest loss (ha)	4,783.35	68,938.35	20,326.14
Access to basic drinking water — rural (%)	30.80	40.91	55.48
Access to basic drinking water — national (%)	64.70	63.26	69.76
Access to basic hygiene — national (%)	—	22.62	26.71
Access to basic sanitation — national (%)	66.30	36.84	40.71

Animal Factors

Average livestock stocks (LSUs)	12,570.24	4,183,733.13	5,551,123.37
Average livestock exports (LSUs)	NA	8,818.17	33,314.93
Average livestock imports (LSUs)	457.16	9,067.12	31,044.50
Mammal species (number)	211.00	291.00	241.65

Eritrea

Completed Assessments and Plans

JEE	PVS Evaluation	PVS Evaluation Follow-Up	PVS Gap Analysis	PVS Legislation	IHR-PVS Bridging Workshop	NAPHS	OHZDP	National AMR Action Plan	NBSAP
2016	2009	-	2011	2019	-	2017	-	2021	2015

Indicator **Country** **Region Average** **Continent Average**

Coordination and Financing

Multi-sector and One Health collaboration/coordination for AMR (1-5)	—	2.25	2.44
Collaborative effort on activities to address zoonoses (0-100)	80.00	54.12	54.23
Current health expenditure per capita (USD)	25.27	130.86	132.25
CFE disbursements (USD)	0.00	1,742,137.45	4,903,032.44

Workforce

Veterinarians (total)	401.00	3,097.00	3,512.00
Veterinarians (per 1,000 people)	NA	0.16	0.17
Public animal health professionals (total)	7.00	212.00	461.00
Public animal health professionals (per 1,000 people)	NA	0.01	0.02
Medical doctors (total)	248.00	3,310.00	8,574.28
Medical doctors (per 1,000 people)	NA	0.42	0.41
Up-to-date multisectoral workforce strategy (1-5)	4.00	2.33	2.19
Progress with strengthening veterinary services (1-5)	—	2.62	2.80

Demographic Factors

Population (total)	3,213,969.00	24,025,701.94	24,185,802.76
Population growth (% , 2010-2019)	NA	23.76	23.73
GNI per capita (USD)	600.00	2,517.78	2,525.37

Environmental and Sanitation Factors

Land area (sq km)	101,000.00	378,644.97	548,414.71
Arable land (% land area)	6.83	18.53	14.14
Forest area (% land area)	10.48	24.89	27.57
Terrestrial protected areas (% land area)	4.87	17.04	16.27
Average primary forest loss (ha)	—	6,271.69	20,326.14
Access to basic drinking water — rural (%)	NA	49.58	55.48
Access to basic drinking water — national (%)	NA	63.02	69.76
Access to basic hygiene — national (%)	—	18.18	26.71
Access to basic sanitation — national (%)	NA	35.66	40.71

Animal Factors

Average livestock stocks (LSUs)	1,843,197.92	6,601,349.50	5,551,123.37
Average livestock exports (LSUs)	445.29	44,401.60	33,314.93
Average livestock imports (LSUs)	484.64	12,869.29	31,044.50
Mammal species (number)	179.00	240.61	241.65

Eswatini

Completed Assessments and Plans

JEE	PVS Evaluation	PVS Evaluation Follow-Up	PVS Gap Analysis	PVS Legislation	IHR-PVS Bridging Workshop	NAPHS	OHZDP	National AMR Action Plan	NBSAP
2018	2007	2015	2015	-	-	2019	-	2020	2017

Indicator **Country** **Region Average** **Continent Average**

Coordination and Financing

Multi-sector and One Health collaboration/coordination for AMR (1-5)	2.00	3.00	2.44
Collaborative effort on activities to address zoonoses (0-100)	60.00	48.00	54.23
Current health expenditure per capita (USD)	264.06	368.75	132.25
CFE disbursements (USD)	0.00	295,395.50	4,903,032.44

Workforce

Veterinarians (total)	1,018.00	1,522.00	3,512.00
Veterinarians (per 1,000 people)	0.90	0.39	0.17
Public animal health professionals (total)	11.00	59.00	461.00
Public animal health professionals (per 1,000 people)	0.01	0.02	0.02
Medical doctors (total)	278.00	9,993.00	8,574.00
Medical doctors (per 1,000 people)	0.24	0.50	0.41
Up-to-date multisectoral workforce strategy (1-5)	1.00	1.80	2.19
Progress with strengthening veterinary services (1-5)	4.00	4.00	2.80

Demographic Factors

Population (total)	1,148,133.00	13,325,978.80	24,185,802.76
Population growth (% , 2010-2019)	7.80	12.44	23.73
GNI per capita (USD)	3,690.00	4,864.00	2,525.37

Environmental and Sanitation Factors

Land area (sq km)	17,200.00	530,134.00	548,414.71
Arable land (% land area)	10.17	7.13	14.14
Forest area (% land area)	28.86	15.87	27.57
Terrestrial protected areas (% land area)	4.26	15.98	16.27
Average primary forest loss (ha)	—	687.29	20,326.14
Access to basic drinking water — rural (%)	60.40	69.02	55.48
Access to basic drinking water — national (%)	69.00	80.62	69.76
Access to basic hygiene — national (%)	24.10	28.70	26.71
Access to basic sanitation — national (%)	58.40	57.74	40.71

Animal Factors

Average livestock stocks (LSUs)	384,334.67	3,654,307.56	5,551,123.37
Average livestock exports (LSUs)	10,268.54	43,602.71	33,314.93
Average livestock imports (LSUs)	13,646.01	64,740.74	31,044.50
Mammal species (number)	166.00	220.60	241.65

Gabon

Completed Assessments and Plans

JEE	PVS Evaluation	PVS Evaluation Follow-Up	PVS Gap Analysis	PVS Legislation	IHR-PVS Bridging Workshop	NAPHS	OHZDP	National AMR Action Plan	NBSAP
2019	2007	-	2011	2010	-	2021	-	-	-

Indicator **Country** **Region Average** **Continent Average**

Coordination and Financing

Multi-sector and One Health collaboration/coordination for AMR (1-5)	–	2.00	2.44
Collaborative effort on activities to address zoonoses (0-100)	20.00	42.22	54.23
Current health expenditure per capita (USD)	215.02	93.32	132.25
CFE disbursements (USD)	0.00	14,066,100.14	4,903,032.44

Workforce

Veterinarians (total)	56.00	1,238.00	3,512.00
Veterinarians (per 1,000 people)	0.03	0.09	0.17
Public animal health professionals (total)	NA	130.00	461.00
Public animal health professionals (per 1,000 people)	NA	0.01	0.02
Medical doctors (total)	1,368.00	5,013.00	8,574.00
Medical doctors (per 1,000 people)	0.65	0.28	0.41
Up-to-date multisectoral workforce strategy (1-5)	2.00	2.12	2.19
Progress with strengthening veterinary services (1-5)	–	2.00	2.80

Demographic Factors

Population (total)	2,172,578.00	19,367,603.00	24,185,802.76
Population growth (% , 2010-2019)	33.80	29.12	23.73
GNI per capita (USD)	7,170.00	2,607.78	2,525.37

Environmental and Sanitation Factors

Land area (sq km)	257,670.00	721,868.89	548,414.71
Arable land (% land area)	1.26	4.51	14.14
Forest area (% land area)	91.37	54.50	27.57
Terrestrial protected areas (% land area)	22.44	20.20	16.27
Average primary forest loss (ha)	16,306.94	68,938.35	20,326.14
Access to basic drinking water – rural (%)	55.10	40.91	55.48
Access to basic drinking water – national (%)	85.80	63.26	69.76
Access to basic hygiene – national (%)	–	22.62	26.71
Access to basic sanitation – national (%)	47.40	36.84	40.71

Animal Factors

Average livestock stocks (LSUs)	126,312.87	4,183,733.13	5,551,123.37
Average livestock exports (LSUs)	0.00	8,818.17	33,314.93
Average livestock imports (LSUs)	5,458.55	9,067.12	31,044.50
Mammal species (number)	227.00	291.00	241.65

Gambia

Completed Assessments and Plans

JEE	PVS Evaluation	PVS Evaluation Follow-Up	PVS Gap Analysis	PVS Legislation	IHR-PVS Bridging Workshop	NAPHS	OHZDP	National AMR Action Plan	NBSAP
2017	2009	-	2012	2016	2021	2021	-	-	2016

Indicator **Country** **Region Average** **Continent Average**

Coordination and Financing

Multi-sector and One Health collaboration/coordination for AMR (1-5)	–	2.20	2.44
Collaborative effort on activities to address zoonoses (0-100)	20.00	55.00	54.23
Current health expenditure per capita (USD)	29.73	58.69	132.25
CFE disbursements (USD)	0.00	2,361,848.00	4,903,032.44

Workforce

Veterinarians (total)	312.00	909.00	3,512.00
Veterinarians (per 1,000 people)	0.14	0.08	0.17
Public animal health professionals (total)	2.00	52.00	461.00
Public animal health professionals (per 1,000 people)	0.00	0.01	0.02
Medical doctors (total)	252.00	5,967.00	8,574.00
Medical doctors (per 1,000 people)	0.11	0.17	0.41
Up-to-date multisectoral workforce strategy (1-5)	3.00	2.03	2.19
Progress with strengthening veterinary services (1-5)	–	2.80	2.80

Demographic Factors

Population (total)	2,347,696.00	24,464,630.38	24,185,802.76
Population growth (% , 2010-2019)	30.90	27.01	23.73
GNI per capita (USD)	750.00	1,335.62	2,525.37

Environmental and Sanitation Factors

Land area (sq km)	10,120.00	378,979.38	548,414.71
Arable land (% land area)	43.48	19.19	14.14
Forest area (% land area)	24.55	27.66	27.57
Terrestrial protected areas (% land area)	4.11	15.52	16.27
Average primary forest loss (ha)	–	6,105.65	20,326.14
Access to basic drinking water – rural (%)	63.40	56.77	55.48
Access to basic drinking water – national (%)	78.00	69.53	69.76
Access to basic hygiene – national (%)	7.90	21.94	26.71
Access to basic sanitation – national (%)	39.20	30.23	40.71

Animal Factors

Average livestock stocks (LSUs)	280,955.60	4,615,777.30	5,551,123.37
Average livestock exports (LSUs)	133.00	20,487.72	33,314.93
Average livestock imports (LSUs)	114.04	36,990.70	31,044.50
Mammal species (number)	182.00	230.06	241.65

Guinea

Completed Assessments and Plans

JEE	PVS Evaluation	PVS Evaluation Follow-Up	PVS Gap Analysis	PVS Legislation	IHR-PVS Bridging Workshop	NAPHS	OHZDP	National AMR Action Plan	NBSAP
2017	2007	2019	2009	2011	2018	2019	-	-	2016

Indicator **Country** **Region Average** **Continent Average**

Coordination and Financing

Multi-sector and One Health collaboration/coordination for AMR (1-5)	2.00	2.20	2.44
Collaborative effort on activities to address zoonoses (0-100)	60.00	55.00	54.23
Current health expenditure per capita (USD)	43.04	58.69	132.25
CFE disbursements (USD)	0.00	2,361,848.00	4,903,032.44

Workforce

Veterinarians (total)	84.00	909.00	3,512.00
Veterinarians (per 1,000 people)	0.01	0.08	0.17
Public animal health professionals (total)	236.00	52.00	461.00
Public animal health professionals (per 1,000 people)	0.02	0.01	0.02
Medical doctors (total)	2,787.00	5,967.00	8,574.00
Medical doctors (per 1,000 people)	0.22	0.17	0.41
Up-to-date multisectoral workforce strategy (1-5)	2.00	2.03	2.19
Progress with strengthening veterinary services (1-5)	2.00	2.80	2.80

Demographic Factors

Population (total)	12,771,246.00	24,464,630.38	24,185,802.76
Population growth (% , 2010-2019)	25.30	27.01	23.73
GNI per capita (USD)	950.00	1,335.62	2,525.37

Environmental and Sanitation Factors

Land area (sq km)	245,720.00	378,979.38	548,414.71
Arable land (% land area)	12.62	19.19	14.14
Forest area (% land area)	25.35	27.66	27.57
Terrestrial protected areas (% land area)	35.65	15.52	16.27
Average primary forest loss (ha)	965.52	6,105.65	20,326.14
Access to basic drinking water – rural (%)	48.70	56.77	55.48
Access to basic drinking water – national (%)	61.90	69.53	69.76
Access to basic hygiene – national (%)	17.40	21.94	26.71
Access to basic sanitation – national (%)	22.70	30.23	40.71

Animal Factors

Average livestock stocks (LSUs)	3,955,912.53	4,615,777.30	5,551,123.37
Average livestock exports (LSUs)	10,670.61	20,487.72	33,314.93
Average livestock imports (LSUs)	15,908.62	36,990.70	31,044.50
Mammal species (number)	295.00	230.06	241.65

Guinea-Bissau

Completed Assessments and Plans

JEE	PVS Evaluation	PVS Evaluation Follow-Up	PVS Gap Analysis	PVS Legislation	IHR-PVS Bridging Workshop	NAPHS	OHZDP	National AMR Action Plan	NBSAP
2019	2008	2015	2009	2008	-	2021	-	-	2016

Indicator **Country** **Region Average** **Continent Average**

Coordination and Financing

Multi-sector and One Health collaboration/coordination for AMR (1-5)	–	2.20	2.44
Collaborative effort on activities to address zoonoses (0-100)	20.00	55.00	54.23
Current health expenditure per capita (USD)	62.58	58.69	132.25
CFE disbursements (USD)	0.00	2,361,848.00	4,903,032.44

Workforce

Veterinarians (total)	95.00	909.00	3,512.00
Veterinarians (per 1,000 people)	0.05	0.08	0.17
Public animal health professionals (total)	10.00	52.00	461.00
Public animal health professionals (per 1,000 people)	0.01	0.01	0.02
Medical doctors (total)	318.00	5,967.00	8,574.00
Medical doctors (per 1,000 people)	0.17	0.17	0.41
Up-to-date multisectoral workforce strategy (1-5)	1.00	2.03	2.19
Progress with strengthening veterinary services (1-5)	–	2.80	2.80

Demographic Factors

Population (total)	1,920,917.00	24,464,630.38	24,185,802.76
Population growth (% ,2010-2019)	26.20	27.01	23.73
GNI per capita (USD)	800.00	1,335.62	2,525.37

Environmental and Sanitation Factors

Land area (sq km)	28,120.00	378,979.38	548,414.71
Arable land (% land area)	10.67	19.19	14.14
Forest area (% land area)	70.71	27.66	27.57
Terrestrial protected areas (% land area)	16.66	15.52	16.27
Average primary forest loss (ha)	358.54	6,105.65	20,326.14
Access to basic drinking water – rural (%)	53.50	56.77	55.48
Access to basic drinking water – national (%)	66.60	69.53	69.76
Access to basic hygiene – national (%)	6.40	21.94	26.71
Access to basic sanitation – national (%)	20.50	30.23	40.71

Animal Factors

Average livestock stocks (LSUs)	577,732.90	4,615,777.30	5,551,123.37
Average livestock exports (LSUs)	0.00	20,487.72	33,314.93
Average livestock imports (LSUs)	117.00	36,990.70	31,044.50
Mammal species (number)	177.00	230.06	241.65

Lesotho

Completed Assessments and Plans

JEE	PVS Evaluation	PVS Evaluation Follow-Up	PVS Gap Analysis	PVS Legislation	IHR-PVS Bridging Workshop	NAPHS	OHZDP	National AMR Action Plan	NBSAP
2017	2007	-	2011	2013	-	2019	-	-	-

Indicator **Country** **Region Average** **Continent Average**

Coordination and Financing

Multi-sector and One Health collaboration/coordination for AMR (1-5)	–	3.00	2.44
Collaborative effort on activities to address zoonoses (0-100)	40.00	48.00	54.23
Current health expenditure per capita (USD)	124.19	368.75	132.25
CFE disbursements (USD)	0.00	295,395.50	4,903,032.44

Workforce

Veterinarians (total)	882.00	1,522.00	3,512.00
Veterinarians (per 1,000 people)	0.43	0.39	0.17
Public animal health professionals (total)	11.00	59.00	461.00
Public animal health professionals (per 1,000 people)	0.01	0.02	0.02
Medical doctors (total)	998.00	9,993.00	8,574.00
Medical doctors (per 1,000 people)	0.47	0.50	0.41
Up-to-date multisectoral workforce strategy (1-5)	2.00	1.80	2.19
Progress with strengthening veterinary services (1-5)	–	4.00	2.80

Demographic Factors

Population (total)	2,125,267.00	13,325,978.80	24,185,802.76
Population growth (% , 2010-2019)	6.50	12.44	23.73
GNI per capita (USD)	1,290.00	4,864.00	2,525.37

Environmental and Sanitation Factors

Land area (sq km)	30,360.00	530,134.00	548,414.71
Arable land (% land area)	14.14	7.13	14.14
Forest area (% land area)	1.14	15.87	27.57
Terrestrial protected areas (% land area)	0.26	15.98	16.27
Average primary forest loss (ha)	–	687.29	20,326.14
Access to basic drinking water – rural (%)	59.30	69.02	55.48
Access to basic drinking water – national (%)	68.60	80.62	69.76
Access to basic hygiene – national (%)	2.10	28.70	26.71
Access to basic sanitation – national (%)	42.80	57.74	40.71

Animal Factors

Average livestock stocks (LSUs)	521,754.75	3,654,307.56	5,551,123.37
Average livestock exports (LSUs)	941.71	43,602.71	33,314.93
Average livestock imports (LSUs)	25,483.52	64,740.74	31,044.50
Mammal species (number)	100.00	220.60	241.65

Liberia

Completed Assessments and Plans

JEE	PVS Evaluation	PVS Evaluation Follow-Up	PVS Gap Analysis	PVS Legislation	IHR-PVS Bridging Workshop	NAPHS	OHZDP	National AMR Action Plan	NBSAP
2016	2013	2019	2016	2018	2018	2018	-	2018	2017

Indicator **Country** **Region Average** **Continent Average**

Coordination and Financing

Multi-sector and One Health collaboration/coordination for AMR (1-5)	2.00	2.20	2.44
Collaborative effort on activities to address zoonoses (0-100)	80.00	55.00	54.23
Current health expenditure per capita (USD)	52.56	58.69	132.25
CFE disbursements (USD)	50,000.00	2,361,848.00	4,903,032.44

Workforce

Veterinarians (total)	NA	909.00	3,512.00
Veterinarians (per 1,000 people)	NA	0.08	0.17
Public animal health professionals (total)	NA	52.00	461.00
Public animal health professionals (per 1,000 people)	NA	0.01	0.02
Medical doctors (total)	246.00	5,967.00	8,574.00
Medical doctors (per 1,000 people)	0.05	0.17	0.41
Up-to-date multisectoral workforce strategy (1-5)	2.00	2.03	2.19
Progress with strengthening veterinary services (1-5)	4.00	2.80	2.80

Demographic Factors

Population (total)	4,937,374.00	24,464,630.38	24,185,802.76
Population growth (% , 2010-2019)	26.90	27.01	23.73
GNI per capita (USD)	610.00	1,335.62	2,525.37

Environmental and Sanitation Factors

Land area (sq km)	96,320.00	378,979.38	548,414.71
Arable land (% land area)	5.19	19.19	14.14
Forest area (% land area)	79.40	27.66	27.57
Terrestrial protected areas (% land area)	4.05	15.52	16.27
Average primary forest loss (ha)	17,874.24	6,105.65	20,326.14
Access to basic drinking water – rural (%)	62.00	56.77	55.48
Access to basic drinking water – national (%)	72.90	69.53	69.76
Access to basic hygiene – national (%)	1.20	21.94	26.71
Access to basic sanitation – national (%)	17.00	30.23	40.71

Animal Factors

Average livestock stocks (LSUs)	229,724.98	4,615,777.30	5,551,123.37
Average livestock exports (LSUs)	NA	20,487.72	33,314.93
Average livestock imports (LSUs)	1,317.95	36,990.70	31,044.50
Mammal species (number)	224.00	230.06	241.65

Libya

Completed Assessments and Plans

JEE	PVS Evaluation	PVS Evaluation Follow-Up	PVS Gap Analysis	PVS Legislation	IHR-PVS Bridging Workshop	NAPHS	OHZDP	National AMR Action Plan	NBSAP
2018	2009	2013	2013	-	-	-	-	2018	-

Indicator **Country** **Region Average** **Continent Average**

Coordination and Financing

Multi-sector and One Health collaboration/coordination for AMR (1-5)	4.00	3.25	2.44
Collaborative effort on activities to address zoonoses (0-100)	80.00	80.00	54.23
Current health expenditure per capita (USD)	NA	193.69	132.25
CFE disbursements (USD)	1,350,000.00	1,177,816.00	4,903,032.44

Workforce

Veterinarians (total)	2,310.00	16,337.00	3,512.00
Veterinarians (per 1,000 people)	0.36	0.32	0.17
Public animal health professionals (total)	750.00	2,884.00	461.00
Public animal health professionals (per 1,000 people)	0.12	0.06	0.02
Medical doctors (total)	13,757.00	35,477.00	8,574.00
Medical doctors (per 1,000 people)	2.09	1.14	0.41
Up-to-date multisectoral workforce strategy (1-5)	2.00	2.75	2.19
Progress with strengthening veterinary services (1-5)	1.00	2.75	2.80

Demographic Factors

Population (total)	6,777,453.00	40,199,717.83	24,185,802.76
Population growth (% ,2010-2019)	9.40	16.18	23.73
GNI per capita (USD)	7,720.00	3,648.33	2,525.37

Environmental and Sanitation Factors

Land area (sq km)	1,759,540.00	1,264,604.12	548,414.71
Arable land (% land area)	0.98	8.55	14.14
Forest area (% land area)	0.12	4.73	27.57
Terrestrial protected areas (% land area)	0.21	10.30	16.27
Average primary forest loss (ha)	-	0.00	20,326.14
Access to basic drinking water – rural (%)	NA	80.02	55.48
Access to basic drinking water – national (%)	98.50	89.08	69.76
Access to basic hygiene – national (%)	-	68.90	26.71
Access to basic sanitation – national (%)	NA	79.56	40.71

Animal Factors

Average livestock stocks (LSUs)	1,526,211.52	8,526,466.35	5,551,123.37
Average livestock exports (LSUs)	7.76	62,432.79	33,314.93
Average livestock imports (LSUs)	135,507.71	74,599.46	31,044.50
Mammal species (number)	167.00	219.17	241.65

Madagascar

Completed Assessments and Plans

JEE	PVS Evaluation	PVS Evaluation Follow-Up	PVS Gap Analysis	PVS Legislation	IHR-PVS Bridging Workshop	NAPHS	OHZDP	National AMR Action Plan	NBSAP
2017	2007	-	2008	2008	-	-	-	-	-

Indicator **Country** **Region Average** **Continent Average**

Coordination and Financing

Multi-sector and One Health collaboration/coordination for AMR (1-5)	–	2.25	2.44
Collaborative effort on activities to address zoonoses (0-100)	20.00	54.12	54.23
Current health expenditure per capita (USD)	19.85	130.86	132.25
CFE disbursements (USD)	1,631,248.00	1,742,137.45	4,903,032.44

Workforce

Veterinarians (total)	2,324.00	3,097.00	3,512.00
Veterinarians (per 1,000 people)	0.09	0.16	0.17
Public animal health professionals (total)	63.00	212.00	461.00
Public animal health professionals (per 1,000 people)	0.00	0.01	0.02
Medical doctors (total)	5,230.00	3,311.00	8,574.00
Medical doctors (per 1,000 people)	0.20	0.42	0.41
Up-to-date multisectoral workforce strategy (1-5)	3.00	2.33	2.19
Progress with strengthening veterinary services (1-5)	–	2.62	2.80

Demographic Factors

Population (total)	26,969,306.00	24,025,701.94	24,185,802.76
Population growth (% , 2010-2019)	27.50	23.76	23.73
GNI per capita (USD)	520.00	2,517.78	2,525.37

Environmental and Sanitation Factors

Land area (sq km)	581,800.00	378,644.97	548,414.71
Arable land (% land area)	5.16	18.53	14.14
Forest area (% land area)	21.39	24.89	27.57
Terrestrial protected areas (% land area)	5.59	17.04	16.27
Average primary forest loss (ha)	64,557.29	6,271.69	20,326.14
Access to basic drinking water – rural (%)	36.30	49.58	55.48
Access to basic drinking water – national (%)	54.40	63.02	69.76
Access to basic hygiene – national (%)	–	18.18	26.71
Access to basic sanitation – national (%)	10.50	35.66	40.71

Animal Factors

Average livestock stocks (LSUs)	5,944,948.00	6,601,349.50	5,551,123.37
Average livestock exports (LSUs)	323.00	44,401.60	33,314.93
Average livestock imports (LSUs)	12,056.00	12,869.29	31,044.50
Mammal species (number)	273.00	240.61	241.65

Malawi

Completed Assessments and Plans

JEE	PVS Evaluation	PVS Evaluation Follow-Up	PVS Gap Analysis	PVS Legislation	IHR-PVS Bridging Workshop	NAPHS	OHZDP	National AMR Action Plan	NBSAP
2019	2007	2014	-	2016	-	2020	-	2017	2016

Indicator **Country** **Region Average** **Continent Average**

Coordination and Financing

Multi-sector and One Health collaboration/coordination for AMR (1-5)	–	2.25	2.44
Collaborative effort on activities to address zoonoses (0-100)	60.0	54.12	54.23
Current health expenditure per capita (USD)	30.4	130.86	132.25
CFE disbursements (USD)	0.0	1,742,137.45	4,903,032.44

Workforce

Veterinarians (total)	1,233.00	3,097.00	3,512.00
Veterinarians (per 1,000 people)	0.07	0.16	0.17
Public animal health professionals (total)	11.00	212.00	461.00
Public animal health professionals (per 1,000 people)	0.00	0.01	0.02
Medical doctors (total)	2,760.00	3,310.00	8,574.00
Medical doctors (per 1,000 people)	0.15	0.42	0.41
Up-to-date multisectoral workforce strategy (1-5)	2.00	2.33	2.19
Progress with strengthening veterinary services (1-5)	–	2.62	2.80

Demographic Factors

Population (total)	18,628,749.00	24,025,701.94	24,185,802.76
Population growth (% , 2010-2019)	28.10	23.76	23.73
GNI per capita (USD)	550.00	2,517.78	2,525.37

Environmental and Sanitation Factors

Land area (sq km)	94,280.00	378,644.97	548,414.71
Arable land (% land area)	38.18	18.53	14.14
Forest area (% land area)	24.22	24.89	27.57
Terrestrial protected areas (% land area)	22.88	17.04	16.27
Average primary forest loss (ha)	20.59	6,271.69	20,326.14
Access to basic drinking water – rural (%)	65.40	49.58	55.48
Access to basic drinking water – national (%)	68.80	63.02	69.76
Access to basic hygiene – national (%)	8.70	18.18	26.71
Access to basic sanitation – national (%)	26.20	35.66	40.71

Animal Factors

Average livestock stocks (LSUs)	2,239,592.05	6,601,349.50	5,551,123.37
Average livestock exports (LSUs)	1,841.34	44,401.60	33,314.93
Average livestock imports (LSUs)	2,266.60	12,869.29	31,044.50
Mammal species (number)	231.00	240.61	241.65

Mauritania

Completed Assessments and Plans

JEE	PVS Evaluation	PVS Evaluation Follow-Up	PVS Gap Analysis	PVS Legislation	IHR-PVS Bridging Workshop	NAPHS	OHZDP	National AMR Action Plan	NBSAP
2017	2008	2019	2010	2011	2018	2018	-	-	2015

Indicator **Country** **Region Average** **Continent Average**

Coordination and Financing

Multi-sector and One Health collaboration/coordination for AMR (1-5)	2.00	2.20	2.44
Collaborative effort on activities to address zoonoses (0-100)	80.00	55.00	54.23
Current health expenditure per capita (USD)	57.88	58.69	132.25
CFE disbursements (USD)	0.00	2,361,848.00	4,903,032.44

Workforce

Veterinarians (total)	236.00	909.00	3,512.00
Veterinarians (per 1,000 people)	0.06	0.08	0.17
Public animal health professionals (total)	—	52.00	461.00
Public animal health professionals (per 1,000 people)	—	0.01	0.02
Medical doctors (total)	821.00	5,967.00	8,574.00
Medical doctors (per 1,000 people)	0.19	0.17	0.41
Up-to-date multisectoral workforce strategy (1-5)	3.00	2.03	2.19
Progress with strengthening veterinary services (1-5)	3.00	2.80	2.80

Demographic Factors

Population (total)	4,525,698.00	24,464,630.38	24,185,802.76
Population growth (% , 2010-2019)	29.50	27.01	23.73
GNI per capita (USD)	1,720.00	1,335.62	2,525.37

Environmental and Sanitation Factors

Land area (sq km)	1,030,700.00	378,979.38	548,414.71
Arable land (% land area)	0.39	19.19	14.14
Forest area (% land area)	0.31	27.66	27.57
Terrestrial protected areas (% land area)	0.62	15.52	16.27
Average primary forest loss (ha)	—	6,105.65	20,326.14
Access to basic drinking water — rural (%)	49.90	56.77	55.48
Access to basic drinking water — national (%)	70.70	69.53	69.76
Access to basic hygiene — national (%)	43.00	21.94	26.71
Access to basic sanitation — national (%)	48.40	30.23	40.71

Animal Factors

Average livestock stocks (LSUs)	4,120,499.79	4,615,777.30	5,551,123.37
Average livestock exports (LSUs)	33,110.00	20,487.72	33,314.93
Average livestock imports (LSUs)	254.21	36,990.70	31,044.50
Mammal species (number)	181.00	230.06	241.65

Mauritius

Completed Assessments and Plans

JEE	PVS Evaluation	PVS Evaluation Follow-Up	PVS Gap Analysis	PVS Legislation	IHR-PVS Bridging Workshop	NAPHS	OHZDP	National AMR Action Plan	NBSAP
2018	2009	-	2011	2011	-	-	-	2017	2017

Indicator **Country** **Region Average** **Continent Average**

Coordination and Financing

Multi-sector and One Health collaboration/coordination for AMR (1-5)	–	2.25	2.44
Collaborative effort on activities to address zoonoses (0-100)	20.00	54.12	54.23
Current health expenditure per capita (USD)	685.95	130.86	132.25
CFE disbursements (USD)	0.00	1,742,137.45	4,903,032.44

Workforce

Veterinarians (total)	178.00	3,097.00	3,512.00
Veterinarians (per 1,000 people)	0.14	0.16	0.17
Public animal health professionals (total)	24.00	212.00	461.00
Public animal health professionals (per 1,000 people)	0.02	0.01	0.02
Medical doctors (total)	3,290.00	3,311.00	8,574.00
Medical doctors (per 1,000 people)	2.60	0.42	0.41
Up-to-date multisectoral workforce strategy (1-5)	1.00	2.33	2.19
Progress with strengthening veterinary services (1-5)	–	2.62	2.80

Demographic Factors

Population (total)	1,265,711.00	24,025,701.94	24,185,802.76
Population growth (% , 2010-2019)	1.20	23.76	23.73
GNI per capita (USD)	12,890.00	2,517.78	2,525.37

Environmental and Sanitation Factors

Land area (sq km)	2,030.00	378,644.97	548,414.71
Arable land (% land area)	36.95	18.53	14.14
Forest area (% land area)	19.08	24.89	27.57
Terrestrial protected areas (% land area)	4.73	17.04	16.27
Average primary forest loss (ha)	–	6,271.69	20,326.14
Access to basic drinking water – rural (%)	99.00	49.58	55.48
Access to basic drinking water – national (%)	99.00	63.02	69.76
Access to basic hygiene – national (%)	–	18.18	26.71
Access to basic sanitation – national (%)	95.50	35.66	40.71

Animal Factors

Average livestock stocks (LSUs)	161,728.32	6,601,349.50	5,551,123.37
Average livestock exports (LSUs)	4,956.20	44,401.60	33,314.93
Average livestock imports (LSUs)	9,059.36	12,869.29	31,044.50
Mammal species (number)	34.00	240.61	241.65

Mozambique

Completed Assessments and Plans

JEE	PVS Evaluation	PVS Evaluation Follow-Up	PVS Gap Analysis	PVS Legislation	IHR-PVS Bridging Workshop	NAPHS	OHZDP	National AMR Action Plan	NBSAP
2016	2008	-	2009	2015	-	2017	2018	2022	2016

Indicator **Country** **Region Average** **Continent Average**

Coordination and Financing

Multi-sector and One Health collaboration/coordination for AMR (1-5)	–	54.12	2.44
Collaborative effort on activities to address zoonoses (0-100)	80.00	2.25	54.23
Current health expenditure per capita (USD)	39.46	130.86	132.25
CFE disbursements (USD)	4,150,000.00	1,742,137.45	4,903,032.44

Workforce

Veterinarians (total)	6,100.00	3,097.00	3,512.00
Veterinarians (per 1,000 people)	0.21	0.16	0.17
Public animal health professionals (total)	68.00	212.00	461.00
Public animal health professionals (per 1,000 people)	0.00	0.01	0.02
Medical doctors (total)	2,570.00	3,311.00	8,574.00
Medical doctors (per 1,000 people)	0.08	0.42	0.41
Up-to-date multisectoral workforce strategy (1-5)	3.00	2.33	2.19
Progress with strengthening veterinary services (1-5)	–	2.62	2.80

Demographic Factors

Population (total)	30,366,043.00	24,025,701.94	24,185,802.76
Population growth (% , 2010-2019)	29.00	23.76	23.73
GNI per capita (USD)	490.00	2,517.78	2,525.37

Environmental and Sanitation Factors

Land area (sq km)	786,380.00	378,644.97	548,414.71
Arable land (% land area)	7.18	18.53	14.14
Forest area (% land area)	47.01	24.89	27.57
Terrestrial protected areas (% land area)	21.57	17.04	16.27
Average primary forest loss (ha)	887.34	6,271.69	20,326.14
Access to basic drinking water – rural (%)	40.00	49.58	55.48
Access to basic drinking water – national (%)	55.70	63.02	69.76
Access to basic hygiene – national (%)	–	18.18	26.71
Access to basic sanitation – national (%)	29.40	35.66	40.71

Animal Factors

Average livestock stocks (LSUs)	1,799,860.65	6,601,349.50	5,551,123.37
Average livestock exports (LSUs)	6.70	44,401.60	33,314.93
Average livestock imports (LSUs)	16,550.66	12,869.29	31,044.50
Mammal species (number)	303.00	240.61	241.65

Namibia

Completed Assessments and Plans

JEE	PVS Evaluation	PVS Evaluation Follow-Up	PVS Gap Analysis	PVS Legislation	IHR-PVS Bridging Workshop	NAPHS	OHZDP	National AMR Action Plan	NBSAP
2016	2008	-	2010	-	-	2017	-	2022	2015

Indicator **Country** **Region Average** **Continent Average**

Coordination and Financing

Multi-sector and One Health collaboration/coordination for AMR (1-5)	–	3.00	2.44
Collaborative effort on activities to address zoonoses (0-100)	60.00	48.00	54.23
Current health expenditure per capita (USD)	427.26	368.75	132.25
CFE disbursements (USD)	195,000.00	295,395.50	4,903,032.44

Workforce

Veterinarians (total)	493.00	1,522.00	3,512.00
Veterinarians (per 1,000 people)	0.20	0.39	0.17
Public animal health professionals (total)	53.00	59.00	461.00
Public animal health professionals (per 1,000 people)	0.02	0.02	0.02
Medical doctors (total)	1,445.00	9,993.00	8,574.00
Medical doctors (per 1,000 people)	0.59	0.50	0.41
Up-to-date multisectoral workforce strategy (1-5)	2.00	1.80	2.19
Progress with strengthening veterinary services (1-5)	–	4.00	2.80

Demographic Factors

Population (total)	2,494,524.00	13,325,978.80	24,185,802.76
Population growth (% , 2010-2019)	17.70	12.44	23.73
GNI per capita (USD)	5,160.00	4,864.00	2,525.37

Environmental and Sanitation Factors

Land area (sq km)	823,290.00	530,134.00	548,414.71
Arable land (% land area)	0.97	7.13	14.14
Forest area (% land area)	8.15	15.87	27.57
Terrestrial protected areas (% land area)	37.89	15.98	16.27
Average primary forest loss (ha)	–	687.29	20,326.14
Access to basic drinking water – rural (%)	69.20	69.02	55.48
Access to basic drinking water – national (%)	82.50	80.62	69.76
Access to basic hygiene – national (%)	44.60	28.70	26.71
Access to basic sanitation – national (%)	34.50	57.74	40.71

Animal Factors

Average livestock stocks (LSUs)	1,864,820.36	3,654,307.56	5,551,123.37
Average livestock exports (LSUs)	128,245.26	43,602.71	33,314.93
Average livestock imports (LSUs)	65,931.53	64,740.74	31,044.50
Mammal species (number)	259.00	220.60	241.65

Niger

Completed Assessments and Plans

JEE	PVS Evaluation	PVS Evaluation Follow-Up	PVS Gap Analysis	PVS Legislation	IHR-PVS Bridging Workshop	NAPHS	OHZDP	National AMR Action Plan	NBSAP
2018	2008	2019	2012	2014	2019	-	-	-	2015

Indicator **Country** **Region Average** **Continent Average**

Coordination and Financing

Multi-sector and One Health collaboration/coordination for AMR (1-5)	1.0	2.20	2.44
Collaborative effort on activities to address zoonoses (0-100)	20.0	55.00	54.23
Current health expenditure per capita (USD)	31.4	58.69	132.25
CFE disbursements (USD)	1,189,872.00	2,361,848.00	4,903,032.44

Workforce

Veterinarians (total)	847.00	909.00	3,512.00
Veterinarians (per 1,000 people)	0.04	0.08	0.17
Public animal health professionals (total)	90.00	52.00	461.00
Public animal health professionals (per 1,000 people)	0.00	0.01	0.02
Medical doctors (total)	888.00	5,967.00	8,574.00
Medical doctors (per 1,000 people)	0.04	0.17	0.41
Up-to-date multisectoral workforce strategy (1-5)	2.00	2.03	2.19
Progress with strengthening veterinary services (1-5)	2.00	2.80	2.80

Demographic Factors

Population (total)	23,310,719.00	24,464,630.38	24,185,802.76
Population growth (% , 2010-2019)	41.60	27.01	23.73
GNI per capita (USD)	590.00	1,335.62	2,525.37

Environmental and Sanitation Factors

Land area (sq km)	1,266,700.00	378,979.38	548,414.71
Arable land (% land area)	13.97	19.19	14.14
Forest area (% land area)	0.86	27.66	27.57
Terrestrial protected areas (% land area)	17.32	15.52	16.27
Average primary forest loss (ha)	—	6,105.65	20,326.14
Access to basic drinking water — rural (%)	43.60	56.77	55.48
Access to basic drinking water — national (%)	50.30	69.53	69.76
Access to basic hygiene — national (%)	—	21.94	26.71
Access to basic sanitation — national (%)	13.60	30.23	40.71

Animal Factors

Average livestock stocks (LSUs)	10,525,793.68	4,615,777.30	5,551,123.37
Average livestock exports (LSUs)	76,457.01	20,487.72	33,314.93
Average livestock imports (LSUs)	1,350.20	36,990.70	31,044.50
Mammal species (number)	200.00	230.06	241.65

Nigeria

Completed Assessments and Plans

JEE	PVS Evaluation	PVS Evaluation Follow-Up	PVS Gap Analysis	PVS Legislation	IHR-PVS Bridging Workshop	NAPHS	OHZDP	National AMR Action Plan	NBSAP
2017	2007	2019	2010	2011	2019	2018, 2019	-	2017	2015

Indicator **Country** **Region Average** **Continent Average**

Coordination and Financing

Multi-sector and One Health collaboration/coordination for AMR (1-5)	3.00	2.20	2.44
Collaborative effort on activities to address zoonoses (0-100)	60.00	55.00	54.23
Current health expenditure per capita (USD)	71.47	58.69	132.25
CFE disbursements (USD)	10,133,049.00	2,361,848.00	4,903,032.44

Workforce

Veterinarians (total)	404.00	909.00	3,512.00
Veterinarians (per 1,000 people)	0.00	0.08	0.17
Public animal health professionals (total)	52.00	52.00	461.00
Public animal health professionals (per 1,000 people)	0.00	0.01	0.02
Medical doctors (total)	74,543.00	5,967.00	8,574.00
Medical doctors (per 1,000 people)	0.38	0.17	0.41
Up-to-date multisectoral workforce strategy (1-5)	2.00	2.03	2.19
Progress with strengthening veterinary services (1-5)	4.00	2.80	2.80

Demographic Factors

Population (total)	200,963,603.00	24,464,630.38	24,185,802.76
Population growth (% ,2010-2019)	26.80	27.01	23.73
GNI per capita (USD)	2,030.00	1,335.62	2,525.37

Environmental and Sanitation Factors

Land area (sq km)	910,770.00	378,979.38	548,414.71
Arable land (% land area)	37.33	19.19	14.14
Forest area (% land area)	23.93	27.66	27.57
Terrestrial protected areas (% land area)	13.93	15.52	16.27
Average primary forest loss (ha)	9,888.00	6,105.65	20,326.14
Access to basic drinking water – rural (%)	55.60	56.77	55.48
Access to basic drinking water – national (%)	71.40	69.53	69.76
Access to basic hygiene – national (%)	41.90	21.94	26.71
Access to basic sanitation – national (%)	39.20	30.23	40.71

Animal Factors

Average livestock stocks (LSUs)	24,515,370.73	4,615,777.30	5,551,123.37
Average livestock exports (LSUs)	21.26	20,487.72	33,314.93
Average livestock imports (LSUs)	248,510.00	36,990.70	31,044.50
Mammal species (number)	380.00	230.06	241.65

Rwanda

Completed Assessments and Plans

JEE	PVS Evaluation	PVS Evaluation Follow-Up	PVS Gap Analysis	PVS Legislation	IHR-PVS Bridging Workshop	NAPHS	OHZDP	National AMR Action Plan	NBSAP
2018	2008	2019	2011	2014	-	2019	2017	2022	2017

Indicator **Country** **Region Average** **Continent Average**

Coordination and Financing

Multi-sector and One Health collaboration/coordination for AMR (1-5)	–	2.25	2.44
Collaborative effort on activities to address zoonoses (0-100)	60.0	54.12	54.23
Current health expenditure per capita (USD)	51.4	130.86	132.25
CFE disbursements (USD)	0.0	1,742,137.45	4,903,032.44

Workforce

Veterinarians (total)	4,221.00	3,097.00	3,512.00
Veterinarians (per 1,000 people)	0.34	0.16	0.17
Public animal health professionals (total)	276.00	212.00	461.00
Public animal health professionals (per 1,000 people)	0.02	0.01	0.02
Medical doctors (total)	1,492.00	3,311.00	8,574.00
Medical doctors (per 1,000 people)	0.12	0.42	0.41
Up-to-date multisectoral workforce strategy (1-5)	3.00	2.33	2.19
Progress with strengthening veterinary services (1-5)	–	2.62	2.80

Demographic Factors

Population (total)	12,626,938.00	24,025,701.94	24,185,802.76
Population growth (% , 2010-2019)	25.80	23.76	23.73
GNI per capita (USD)	830.00	2,517.78	2,525.37

Environmental and Sanitation Factors

Land area (sq km)	24,670.00	378,644.97	548,414.71
Arable land (% land area)	46.68	18.53	14.14
Forest area (% land area)	11.15	24.89	27.57
Terrestrial protected areas (% land area)	9.11	17.04	16.27
Average primary forest loss (ha)	18.75	6,271.69	20,326.14
Access to basic drinking water – rural (%)	52.60	49.58	55.48
Access to basic drinking water – national (%)	57.70	63.02	69.76
Access to basic hygiene – national (%)	4.60	18.18	26.71
Access to basic sanitation – national (%)	66.60	35.66	40.71

Animal Factors

Average livestock stocks (LSUs)	1,241,520.92	6,601,349.50	5,551,123.37
Average livestock exports (LSUs)	7,652.43	44,401.60	33,314.93
Average livestock imports (LSUs)	6,689.46	12,869.29	31,044.50
Mammal species (number)	248.00	240.61	241.65

São Tomé and Príncipe

Completed Assessments and Plans

JEE	PVS Evaluation	PVS Evaluation Follow-Up	PVS Gap Analysis	PVS Legislation	IHR-PVS Bridging Workshop	NAPHS	OHZDP	National AMR Action Plan	NBSAP
2019	2013	-	-	-	-	-	-	-	2016

Indicator **Country** **Region Average** **Continent Average**

Coordination and Financing

Multi-sector and One Health collaboration/coordination for AMR (1-5)	—	2.00	2.44
Collaborative effort on activities to address zoonoses (0-100)	20.00	42.22	54.23
Current health expenditure per capita (USD)	108.45	93.32	132.25
CFE disbursements (USD)	150,000.00	14,066,100.14	4,903,032.44

Workforce

Veterinarians (total)	65.00	1,237.89	3,512.36
Veterinarians (per 1,000 people)	0.31	0.09	0.17
Public animal health professionals (total)	7.00	130.14	461.00
Public animal health professionals (per 1,000 people)	0.03	0.01	0.02
Medical doctors (total)	105.00	5,012.89	8,574.28
Medical doctors (per 1,000 people)	0.49	0.28	0.41
Up-to-date multisectoral workforce strategy (1-5)	2.00	2.12	2.19
Progress with strengthening veterinary services (1-5)	—	2.00	2.80

Demographic Factors

Population (total)	215,048.00	19,367,603.00	24,185,802.76
Population growth (% , 2010-2019)	19.20	29.12	23.73
GNI per capita (USD)	1,950.00	2,607.78	2,525.37

Environmental and Sanitation Factors

Land area (sq km)	960.00	721,868.89	548,414.71
Arable land (% land area)	4.17	4.51	14.14
Forest area (% land area)	54.71	54.50	27.57
Terrestrial protected areas (% land area)	29.26	20.20	16.27
Average primary forest loss (ha)	—	68,938.35	20,326.14
Access to basic drinking water — rural (%)	77.00	40.91	55.48
Access to basic drinking water — national (%)	84.30	63.26	69.76
Access to basic hygiene — national (%)	41.30	22.62	26.71
Access to basic sanitation — national (%)	43.00	36.84	40.71

Animal Factors

Average livestock stocks (LSUs)	10,924.03	4,183,733.13	5,551,123.37
Average livestock exports (LSUs)	2.08	8,818.17	33,314.93
Average livestock imports (LSUs)	424.80	9,067.12	31,044.50
Mammal species (number)	38.00	291.00	241.65

Seychelles

Completed Assessments and Plans

JEE	PVS Evaluation	PVS Evaluation Follow-Up	PVS Gap Analysis	PVS Legislation	IHR-PVS Bridging Workshop	NAPHS	OHZDP	National AMR Action Plan	NBSAP
2018	2011	-	2014	2016	-	-	-	-	2015

Indicator **Country** **Region Average** **Continent Average**

Coordination and Financing

Multi-sector and One Health collaboration/coordination for AMR (1-5)	–	2.25	2.44
Collaborative effort on activities to address zoonoses (0-100)	80.00	54.12	54.23
Current health expenditure per capita (USD)	839.77	130.86	132.25
CFE disbursements (USD)	0.00	1,742,137.45	4,903,032.44

Workforce

Veterinarians (total)	19.00	3,097.00	3,512.00
Veterinarians (per 1,000 people)	0.20	0.16	0.17
Public animal health professionals (total)	4.00	212.00	461.00
Public animal health professionals (per 1,000 people)	0.04	0.01	0.02
Medical doctors (total)	220.00	3,311.00	8,574.00
Medical doctors (per 1,000 people)	2.25	0.42	0.41
Up-to-date multisectoral workforce strategy (1-5)	2.00	2.33	2.19
Progress with strengthening veterinary services (1-5)	–	2.62	2.80

Demographic Factors

Population (total)	97,625.00	24,025,701.94	24,185,802.76
Population growth (% , 2010-2019)	8.80	23.76	23.73
GNI per capita (USD)	15,790.00	2,517.78	2,525.37

Environmental and Sanitation Factors

Land area (sq km)	460.00	378,644.97	548,414.71
Arable land (% land area)	0.33	18.53	14.14
Forest area (% land area)	73.26	24.89	27.57
Terrestrial protected areas (% land area)	49.64	17.04	16.27
Average primary forest loss (ha)	–	6,271.69	20,326.14
Access to basic drinking water – rural (%)	NA	49.58	55.48
Access to basic drinking water – national (%)	96.20	63.02	69.76
Access to basic hygiene – national (%)	–	18.18	26.71
Access to basic sanitation – national (%)	NA	35.66	40.71

Animal Factors

Average livestock stocks (LSUs)	3,160.19	6,601,349.50	5,551,123.37
Average livestock exports (LSUs)	0.20	44,401.60	33,314.93
Average livestock imports (LSUs)	610.87	12,869.29	31,044.50
Mammal species (number)	34.00	240.61	241.65



EcoHealth Alliance