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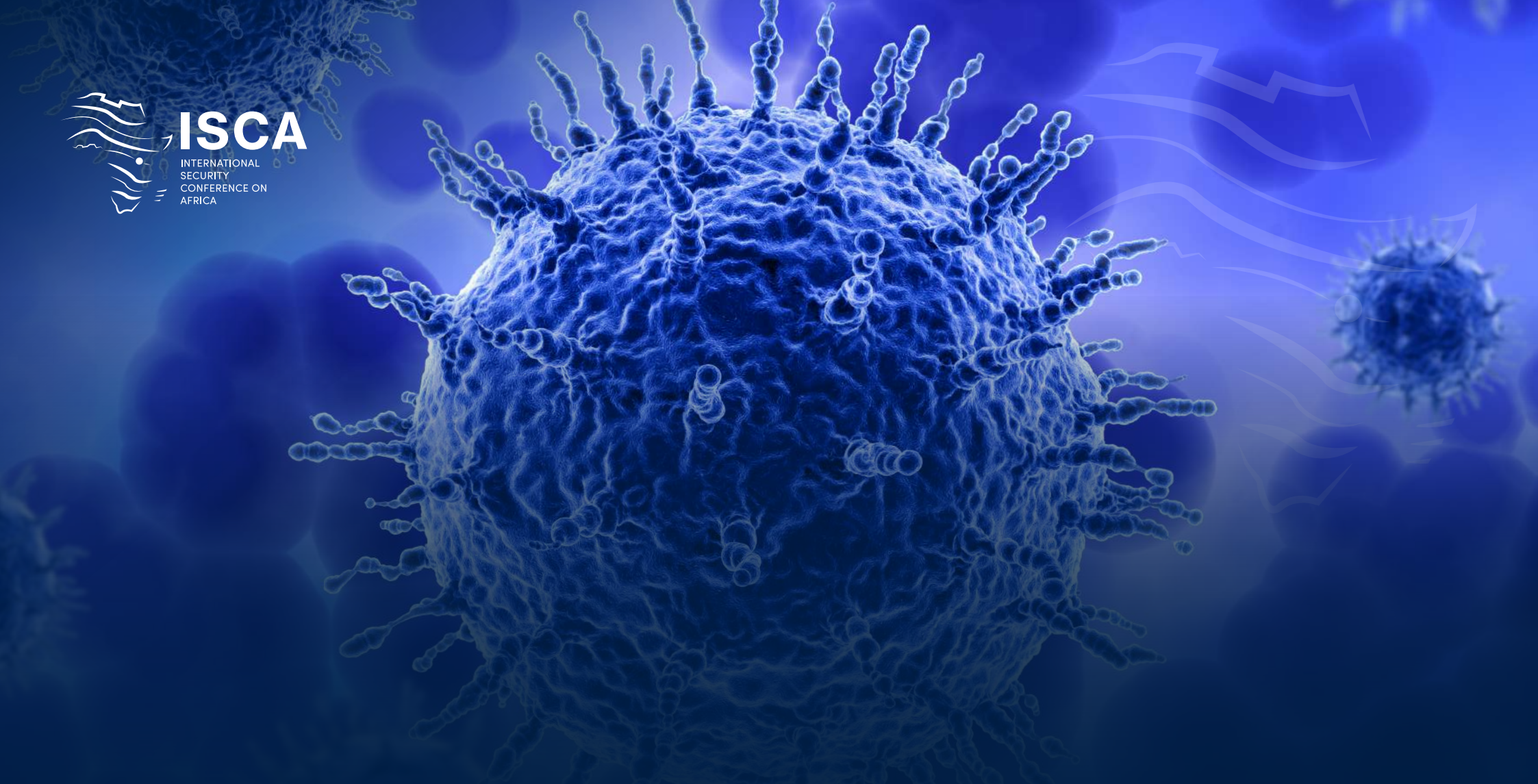

BIOSAFETY AND BIOSECURITY IN AFRICA:

A NARRATIVE REVIEW OF CAPACITIES, GAPS, AND PREPAREDNESS FOR EMERGING BIOLOGICAL THREATS

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He has led and contributed to numerous internationally funded research projects spanning One Health, Biosecurity, climate change adaptation, science, technology and innovation (STI), innovation systems, development and policy analysis, biosecurity, and private sector engagement. Dr Bobadoye has traveled to over 50 countries, delivering keynote addresses and technical presentations at major global forums on climate change, sustainability, health security, and biosecurity.

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LIST OF ABBREVIATIONS AND ACRONYMS

Abbreviation	Meaning
SSA	Sub-Saharan Africa
PHE	Public Health Emergency
WHO	World Health Organization
EIDs	Emerging Infectious Diseases
WMDs	Weapons of Mass Destruction
CDC	Centers for Disease Control
IHR	International Health Regulations
BWC	Biological Weapons Convention

Abbreviation	Meaning
UNSCR	United Nations Security Council
BSBS	Biosafety and Biosecurity
BTWC	Biological and Toxin Weapons Convention
CBM	Confidence-Building Measures
CBRN	Chemical, Biological, Radiological, and Nuclear
GP	Global Partnership
NSS	Nuclear Security Summit
GHSA	Global Health Security Agenda

LIST OF ABBREVIATIONS AND ACRONYMS

Abbreviation	Meaning
BSWG	Biological Security Working Group
CSWG	Chemical Security Working Group
NRWSG	Nuclear & Radiological Security Working Group
UNODA	United Nations Office of Disarmament Affairs
IFBA	Federation of Biosafety
PHEIC	Public Health Emergency of International Concern
JEE	Joint External Evaluation
GMOs	Genetically Modified Organisms

Abbreviation	Meaning
LMOs	Living Modified Organisms
NBMA	National Biosafety Management Agency
NCNRRCVLF	National Committee on Naming, Registration, and Release of Crop Varieties
USDTRA	United States Defense Threat Reduction Agency
POE	Point of Entry
GHSI	Global Health Security Index
SIMBA	Signature Initiative to Mitigate Biological Threats
NBA	National Biosafety Authority

LIST OF ABBREVIATIONS AND ACRONYMS

Abbreviation	Meaning
ASLM	African Society for Laboratory
BBI	Biosafety and Biosecurity Initiative
AU	African Union
WOAH	World Organization for Animal Health
GPWMD	Global Partnership Against the
FIRABioT	Fortifying Institutional Resilience Against Biological Threats
IDSR	Integrated Disease Surveillance and Response
HCAT	High-Consequence Agents and Toxins.
VHFs	Viral Hemorrhagic Fevers
NBMA	Strengthening Laboratory Management Toward Accreditation

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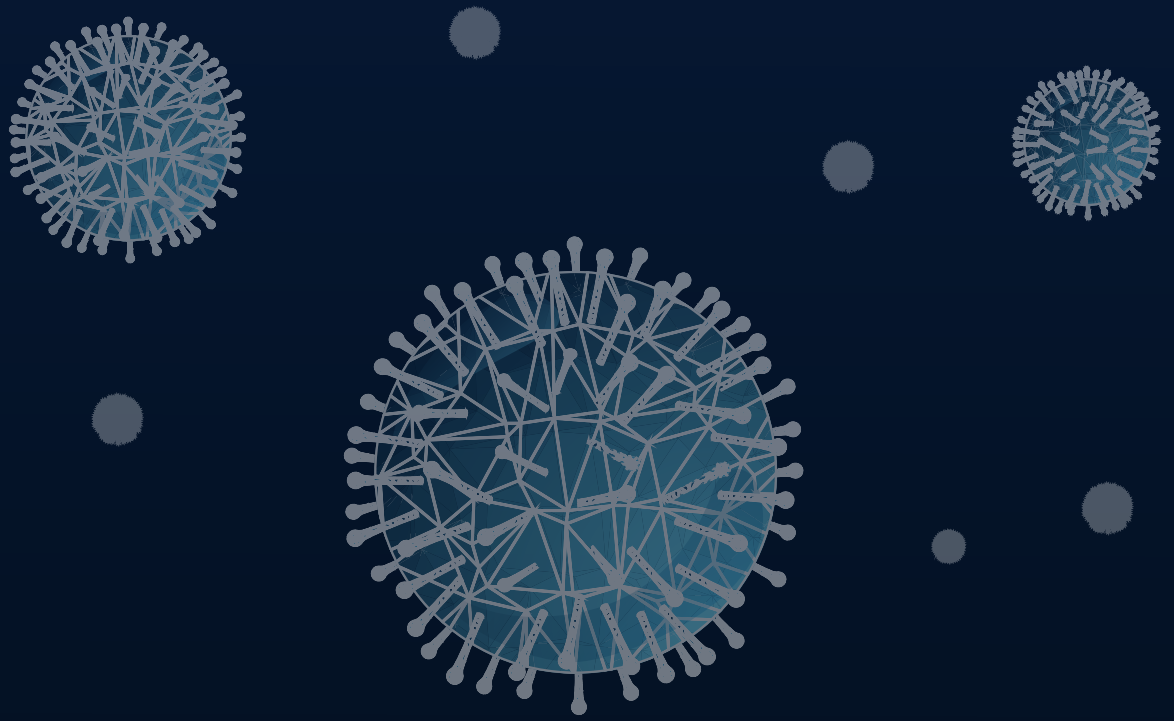
CHAPTER 1: FOUNDATIONS OF BIORISK GOVERNANCE IN SUB-SAHARAN AFRICA



1.0 Introduction

Emerging and re-emerging infectious diseases continue to pose significant threats to public health, economic stability, and sustainable development across Sub-Saharan Africa (SSA). Although these outbreaks often originate from zoonotic sources, their consequences extend far beyond human health, disrupting agricultural systems, livelihoods, and regional stability. Over the past two decades, the region has experienced a substantial rise in Public Health Emergencies (PHEs), driven largely by infectious agents that exploit existing vulnerabilities. According to the World Health Organization, zoonotic disease outbreaks in SSA increased by 63% between 2012 and 2022, compared to the previous decade (WHO, 2022). Furthermore, approximately 30% of all PHEs in Africa are linked to zoonotic events, with a marked surge between 2019 and 2020 when zoonotic pathogens accounted for more than half of all reported emergencies (WHO, 2021).

This worrying trend is shaped by interconnected structural drivers, including rapid urbanization, expanding human–wildlife contact, ecosystem degradation, and climate-sensitive shifts in pathogen ecology (Grace et al., 2017). Socioeconomic vulnerabilities such as malnutrition, inadequate immunization coverage, and limited access to healthcare further amplify disease risks (Africa CDC, 2023). These dynamics collectively highlight the region's heightened exposure to both natural and anthropogenic biological threats.

1.1 Biosafety, Biosecurity and the Growing Importance of Biorisk Governance in SSA

Against this backdrop, biosafety and biosecurity have emerged as critical components of regional and global health security. Biosafety focuses on preventing accidental exposure to or release of biological agents through safe laboratory practices and containment systems (WHO, 2020). Biosecurity, on the other hand, aims to prevent unauthorized access, misuse, theft, or deliberate dissemination of biological materials, equipment, and expertise (UNODA, 2020). As SSA countries continue to expand their research, diagnostic, and biotechnology capacities, the absence of strong governance frameworks increases the risk of laboratory accidents, dual-use research misuse, and exploitation by non-state actors (Koblentz, 2021).

The increasing frequency of biological events, combined with rapid technological advancements in genetic engineering, expanding laboratory networks, and evolving security threats, necessitates alignment with global biosafety and biosecurity norms. Global instruments such as the Biological Weapons Convention (BWC), International Health Regulations (IHR 2005), Global Health Security Agenda (GHSA), and United Nations Security Council Resolution 1540 (UNSCR 1540) provide essential obligations and frameworks for guiding national systems (UNSC, 2004; WHO, 2005; GHSA, 2014). However, their practical implementation across SSA remains uneven due to systemic challenges and wide variation in national capacities.

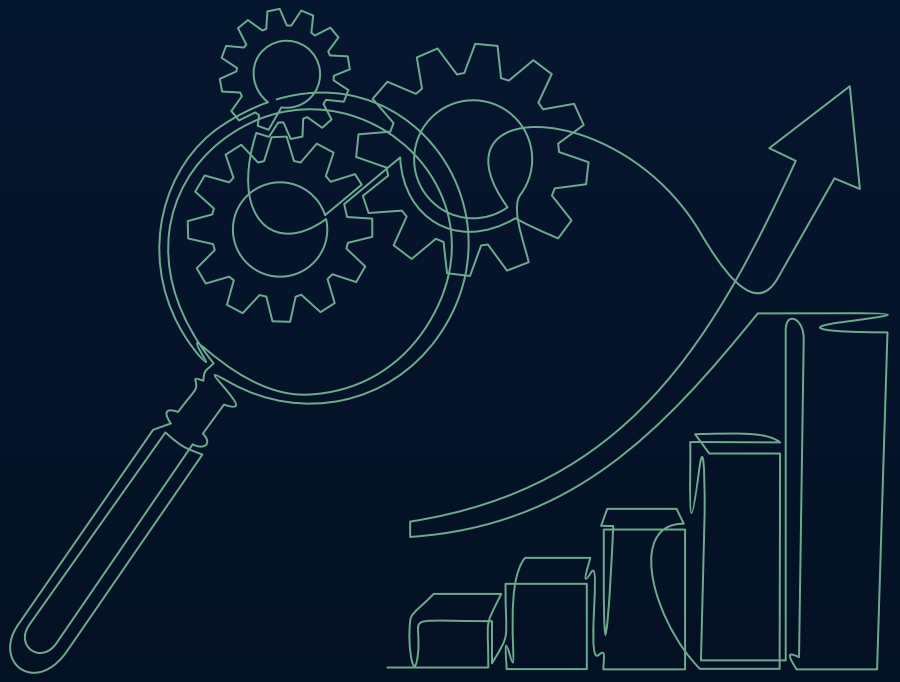
1.1.1 Operational Realities and Capacity Gaps in the Region

Many SSA countries face chronic underinvestment in public health systems, fragmented governance structures, limited laboratory infrastructure, weak regulatory enforcement, and shortages of biosafety officers and trained biorisk management personnel (Ntoumi & Zumla, 2021). These gaps were exposed repeatedly during major outbreaks. The 2014–2016 Ebola epidemic in West Africa demonstrated the consequences of inadequate surveillance systems, absence of functional emergency operations centers, and weak cross-border coordination, despite affected countries being IHR State Parties (Moon et al., 2015). COVID-19 further revealed deficits in laboratory biosecurity governance, including insufficient genomic sequencing capacity, weak material transfer controls, and limited oversight of dual-use research (Nkengasong & Tessema, 2020). Mpox outbreaks since 2022 highlighted the absence of national diagnostic guidelines and inconsistent biosafety level practices for orthopoxviral handling (WHO, 2023). Recurrent cholera outbreaks continue to underscore failures in environmental biosafety, WASH systems, and risk communication (UNICEF, 2022), while recent Marburg virus outbreaks in Ghana, Tanzania, DRC, and Equatorial Guinea exposed persistent gaps in specimen transport, preparedness planning, and implementation of minimum biosafety standards (WHO, 2023).

Collectively, these events reveal a persistent disconnect between policy frameworks and operational readiness. Although many SSA countries have drafted national biosafety guidelines or BWC-related legislation, few have fully implemented or updated them, and several lack functional national authorities for biosafety and biosecurity oversight (UNODA, 2022). Submissions of BWC Confidence-Building Measures (CBMs) remain low, reflecting institutional fragility and technical capacity gaps (BWC ISU, 2023). Regional disparities also persist: countries such as South Africa, Kenya, Uganda, and Nigeria have made measurable progress in developing laboratory regulatory systems and epidemic intelligence units, whereas others lack basic biosafety legislation or coherent national coordination structures (Africa CDC, 2023).
Regional institutions play a growing role in closing these deficits. The Africa CDC coordinates continental biosafety and biosecurity programs, including the Biosafety and Biosecurity Initiative and support for Member States in developing national biorisk frameworks and JEE implementation (Africa CDC, 2022). Sub-regional bodies including ECOWAS and the East African Community (EAC) also strengthen cross-border surveillance, laboratory networks, and emergency response mechanisms, thereby promoting harmonization and capacity-building across Member States (ECOWAS WAHO, 2021).

Given the region's high burden of infectious disease outbreaks and its increasing involvement in biotechnology, a comprehensive assessment of biosafety and biosecurity systems is urgently needed. Understanding current capacities, identifying policy and institutional shortcomings, and mapping persistent vulnerabilities will support efforts to strengthen preparedness and response to emerging biological threats. Therefore, this narrative review seeks to:
1.Examine global discourses and frameworks guiding biosafety and biosecurity, including the BWC, IHR, GHSA, and UNSCR 1540;
2.Assess policy and institutional architectures governing biosafety and biosecurity practices within Sub-Saharan Africa; and
3.Identify persistent capacity gaps, challenges, and regional vulnerabilities that shape preparedness for emerging biological threats.
guiding national systems (UNSC, 2004; WHO, 2005; GHSA, 2014). However, their practical implementation across SSA remains uneven due to systemic challenges and wide variation in national capacities.

CHAPTER 2: METHODOLOGICAL APPROACH AND CONCEPTUAL FRAMEWORK FOR BIORISK ANALYSIS



2.0 Methodology

This study adopted a qualitative research design combining a systematic desk review with key informant interviews (KIIs) to ensure data triangulation and strengthen the validity of findings.
Document selection: Documents were selected based on (i) relevance to biosafety, biosecurity, biobanking, and public health preparedness; (ii) publication within the last 10–15 years to ensure contemporaneity; (iii) regional or national scope; and (iv) credibility of source (e.g., peer-reviewed journals, Africa CDC, WHO, AU, national ministries, and legally recognized policy frameworks). A total of nineteen documents met the inclusion criteria following title and abstract screening and full-text review.
Desk review: The desk-based analysis covered regional bodies (Africa CDC, AU, ECOWAS, EAC), and national biosafety/biosecurity systems in selected countries representing West, East, Central, and Southern Africa (e.g., Nigeria, Ghana, Kenya, Uganda, Rwanda, South Africa, and Tanzania). Documents reviewed included scientific publications, national strategies, regulatory instruments, global biosecurity databases, institutional assessments, and reports from international summits and conferences.

Key Informant Interviews: A total of four KIIs were conducted with stakeholders including national biosafety regulators, laboratory scientists, public health emergency officials, and regional biosafety/biosecurity focal persons. Interviews validated desk-review findings and provided contextual insights into national implementation practices, institutional capacities, and operational challenges.
Data Analysis: Data from documents and KIIs were analyzed using thematic content analysis. Codes were developed deductively from the research questions and inductively from emerging themes. Convergence and divergence across sources were used to refine findings.
Bias and Limitation: Potential biases include variability in country-level data availability, unequal representation across regions, and reliance on publicly accessible documents that may not reflect all ongoing initiatives. KIIs may also reflect institutional perspectives rather than national consensus. These limitations were mitigated through triangulation across multiple data sources and stakeholder groups.

2.1 Conceptual Framework for Biosafety and Biosecurity in SSA

A layered flow-chart linking international drivers to national governance (Fig 1). At the top is Global Narratives on Biosafety and Biosecurity, broad forces such as the proliferation of international agreements, rising emerging infectious disease (EID) threats, expanding biological research, and environmental change (climate variability, deforestation). These global narratives feed into concrete International Instruments (treaties, protocols, agreements) for example, the WHO's International Health Regulations (IHR, 2005), the Biological Weapons Convention (BWC), and others which compel nations to develop biosafety/biosecurity measures. At the national level, these instruments inform Policies, Institutions, and Legislation. In the diagram these three elements are shown in a column or sequence, representing domestic governance: national biosafety policies, the institutional bodies or oversight agencies, and relevant laws or regulations. At the bottom is "Biosafety and Biosecurity in Africa", the outcome shaped by this policy chain. Flanking the framework are contextual factors: on one side, Africa Biosecurity Threats (e.g. zoonotic spillover from deforestation or urbanization) highlighting regional risks; on the other, Policy Gaps and Limitations (such as weak political commitment, lack of legal mandates, or coordination shortfalls) emphasizing barriers. The framework illustrates how global agendas and national governance structures converge to determine the state of biosafety/biosecurity across Sub-Saharan Africa.

2.1.1 Relevance and Practical Application

This framework is well suited for policy analysis because it explicitly connects global mandates with national action. International health/security initiatives (e.g. the Global Health Security Agenda) stress that countries must build “comprehensive, sustainable and legally embedded” national biosafety oversight systems (Orelle, et la., 2021). By mapping treaties and declarations down through policies, institutions, and laws, analysts can assess whether each country has translated those obligations into concrete measures. For example, Africa CDC’s Biosafety & Biosecurity Initiative is designed so that all Member States comply with national, regional and global requirements and domesticate a regional legal framework into national law. If a country has ratified the IHR or BWC but lacks a national biosafety law or agency, the framework immediately reveals that gap (IFBA, 2022).
By structuring the analysis into layers, this model also highlights real world gaps. Evaluations of African biosafety systems frequently note weak governance e.g. insufficient political commitment or undefined legal mandates that undermine policy implementation (ASLM, 2025). Embedding “Policy Gaps and Limitations” in the framework reminds analysts to look for these shortfalls. In practice, this helps public health officials and policymakers see where action is needed.

Furthermore, the framework supports sustainability. By making links from global narratives through to local legislation, it promotes an integrated One Health approach that experts say is essential for Africa (Otu et al., 2021). It encourages harmonizing biosafety laws with international norms (thereby avoiding policy fragmentation) This framework help to guides analysts to examine the exact policy tiers that affect biological safety, identifies where international commitments are unmet at national level, and thus helps build robust, sustainable health security systems across Africa (Orelle, et la., 2021).

The framework draws on literature and reports describing biosafety governance in Africa, which emphasize global-to-local linkages. For example, Africa CDC documents underline the need for member states to align national policies with treaties like the IHR and BWC. Evaluations of African programs highlight that political commitment, legal clarity, and institutional capacity critically determine outcomes. The conceptual framework brings all these threads together into one analytical tool.

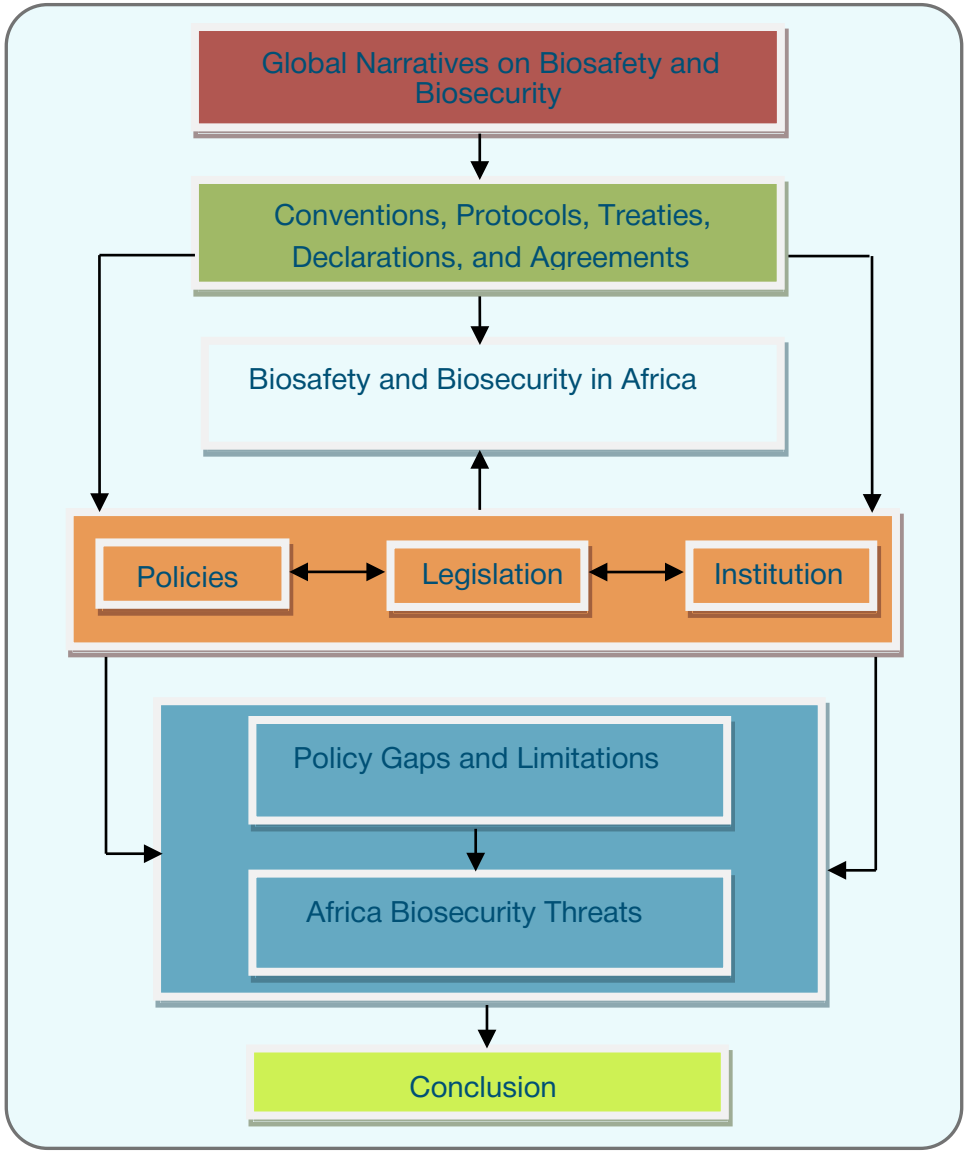


Figure 1: Conceptual Framework for Analysis

2.1.2 Biosafety and Biosecurity Frameworks

The global recognition of risks associated with the accidental exposure or deliberate release of pathogens and toxins has long been established. During the late 20th and early 21st centuries, several international frameworks addressing biosafety and biosecurity were adopted. Prominent among these are the Biological Weapons Convention (1975), the Global Partnership Against the Spread of Weapons and Materials of Mass Destruction (2002), the United Nations Security Council Resolution 1540 (2004), the International Health Regulations (2005), and the Global Health Security Agenda (2014). Collectively, these instruments are complementary, working toward shared objectives that enhance global biosafety and biosecurity capacities.

CHAPTER 3: GLOBAL DISARMAMENT AND INTERNATIONAL SECURITY FRAMEWORKS

3.0 The Biological Weapons Convention (BWC)

The Convention on the Prohibition of the Development, Production, and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction commonly called the Biological Weapons Convention (BWC) forms the central international legal framework for biological disarmament. Adopted in 1972 and entering into force in 1975, it was the first treaty to comprehensively ban an entire class of weapons of mass destruction (United Nations Office for Disarmament Affairs [UNODA], 2024). The BWC prohibits the development, production, acquisition, retention, and use of biological and toxin weapons and remains in force indefinitely.

As of May 2025, 189 States Parties had ratified or acceded to the Convention, with Kiribati most recently joining (BWC ISU, 2023). Over successive review conferences, the treaty's implementation has deepened. The Second Review Conference (1986) introduced Confidence-Building Measures (CBMs). Subsequently, the Third (1991) and Fourth (1996) Review Conferences examined verification options and strengthened Article X on peaceful cooperation. The Fifth Review Conference (2001–2002) initiated the intersessional process, while the Ninth Review Conference (2022) mandated a Working Group to develop concrete, possibly legally binding institutional measures (BWC ISU, 2023). The Tenth Review Conference, held in August 2025, advanced these discussions.

3.1 BWC Framework, Repeated Gaps in Sub-Saharan Africa (SSA), and Implications for Regional Health Security

Despite broad political support for the BWC, implementation across Sub-Saharan Africa remains uneven, shaped by systemic gaps in biosafety, biosecurity, and institutional capacity. Many SSA states lack comprehensive national biosafety and biosecurity legislation or maintain outdated frameworks that do not align with emerging biotechnology threats (Africa CDC, 2023; ECOWAS WAHO, 2021).

Institutionally, many countries lack designated national BWC authorities or functional mechanisms to coordinate reporting, compliance, and emergency response. Regional bodies such as Africa CDC and ECOWAS have attempted to strengthen regulatory harmonization, laboratory accreditation, and emergency preparedness; however, progress varies widely (Africa CDC, 2022; ECOWAS WAHO, 2021). These deficiencies intersect with wider challenges porous borders, high zoonotic disease burden, limited disease-detection capacity, and persistent underinvestment in health systems.

The implications for regional health security are significant. Weak BWC adherence increases the risk of undetected misuse of biological agents, exacerbates vulnerability to epidemics, and limits Africa's engagement in global biosecurity governance. Furthermore, inadequate bio surveillance and laboratory systems undermine early detection of natural or deliberate outbreaks, complicating response coordination and increasing regional spillover risks. Strengthening BWC implementation in SSA is therefore essential not only for treaty compliance but also for advancing One Health security, biotechnology governance, and cross-border epidemic preparedness.

3.1.1 BWC Status and Legislation in SSA Countries

Biosafety/Biosecurity laws: Most of the listed SSA countries (table 1) do not have dedicated biosafety or biosecurity legislation. Only a few SSA countries have a national biosafety and/or biosecurity policy or legislation in place, with some of the most prominent examples being Nigeria, Kenya, Botswana and South Africa (Cameron. et al., 2017). A growing number of SSA countries have developed or are in the process of developing these regulatory frameworks, often in compliance with international agreement like the Cartagena Protocol on Biosafety (CPB). According to the UN Office of Disarmament Affairs, several countries in SSA have functional laws and regulations including Nigeria with a robust framework named the National Biosafety Management Agency Act of 2015 amended in 2019 specifically to capture biosecurity. Other nations include Kenya, South Africa, Rwanda, Sierra Leone, Uganda, Zimbabwe, Sudan, Malawi, Mozambique, Eswatini, Niger, Ghana, Burkina Faso, Ethiopia and Senegal. All have some form of biosafety laws or national biosafety frameworks in place (UNODA, 2024).

Confidence-Building Measures reports reveal only a handful (14) of SSA States have ever submitted any CBM reports. Those include countries like Botswana, Ghana, Kenya, Namibia, Nigeria, South Africa, Tanzania, Uganda, Zambia, Zimbabwe, among a few others. By contrast, the rest of the listed countries have never provided a CBM report (Pate & Duneton, 2025). Below lies the enlisted SSA nations under the BWC registry.

TABLE 1: STATUS OF SUB-SAHARAN AFRICAN COUNTRIES UNDER THE BIOLOGICAL WEAPON CONVENTION

Country	Signatory	Meaning
1.Benin	Yes: 4/10/1972	Ratification: 4/25/1975
2.Burkina Faso	Yes:	Accession: 4/17/1991
3.Gambia	Yes:8/8/1972	Ratification:11/21/1991
4.Ghana	Yes:4/10/1972	Ratification:6/6/1975
5.Guinea	Yes:11/10/2016	Accession:11/10/2016
6.Guinea Bissau	Yes:	Accession:8/20/1976
7.Cote d'Ivoire	Yes: 5/23/1972	Ratification: 3/23/2016
8.Liberia	Yes:4/14/1972	Ratification: 11/4/2016

Country	Signatory	Meaning
9.Mali	Yes: 4/10/1972	Ratification: 11/25/2002
10.Mauritania	Yes:	Accession: 1/28/2015
11.Niger	Yes: 4/21/1972	Ratification: 6/23/1972
12.Nigeria	Yes: 4/10/1972	Ratification:7/9/1973
13.Senegal	Yes: 4/10/1972	Ratified: 3/26/1975
14.Sierra Leone	Yes: 11/24/1972	Ratified: 6/29/1976
15.Togo	Yes: 4/10/1972	Ratified: 11/10/1976
16.South/Africa	Yes: 4/10/1972	Ratified: 30/03/1975
17.Uganda	Yes: 04/10/1972	Ratified: 26/03/1975
18.Ethiopia	Yes: 04/10/1972	Ratified: 26/03/1975
19.Rwanda	Yes: 04/10/1972	Ratified: 26/03/1975
20.São Tomé and Príncipe	Yes 04/10/1972	Ratified: 26/03/1975
21.Seychelles	Yes: 04/10/1972	Ratified: 26/03/1975

Country	Signatory	Meaning
22.Tanzania	Yes: 04/10/1972	Ratified: 26/03/1975
23.Mauritius	Yes: 04/10/1972	Ratified: 26/03/1975
24.Mozambique	Yes: 04/10/1972	Ratified: 26/03/1975
25.Gabon	Yes: 04/10/1972	Ratified: 16/08/2007
26.Republic of Congo		Accession: 23/10/1978
27.Madagascar	Yes: 13/10/1972	Ratified: 07/03/2007
28.Malawi	Yes: 04/10/1972	Ratified: 02/04/2013
29.Namibia		Accession 25/02/2022
30.Sudan		Accession 7 November 2003
31.South-Sudan		Accession 15/02/2023
32.Lesotho	Yes 10/04/1972	Ratified: 26/03/1975
33.Eswatini (Swaziland)	Yes: 10/04/1972	Ratified: 26/03/1975
34.Angola	Yes:	Accession: 26/07/2016

Country	Signatory	Meaning
14.Botswana	Yes: 10/04/1972	Ratified: 05/02/1992
15.Burundi	Yes: 10/04/1972	Ratified: 18/10/2011
16.Cabo Verde (Cape Verde)	Yes: 10/04/1972	Accession: 20/10/1977
17.Central African Republic	Yes: 10/04/1972	Ratified: 25/09/2018
18.Congo (DRC)	Yes: 10/04/1972	Ratified: 26/03/1975
19.Zambia		Accession: 15/01/2008
20.Zimbabwe		Accession: 05/11/1990

CJAD: Cooperation and Judicial Assistance Database

3.1.2 Biosecurity Risk in SSA Countries

Sub-Saharan Africa faces several unique biosecurity challenges. Many countries lack up-to-date pathogen inventories and control systems (e.g. stock management, secure labs), hampering threat detection (WHO, 2015). This is compounded by porous borders and high mobility, as seen in West Africa where population movements (often 7times global norms) enabled rapid cross-border spread of Ebola (World bank, 2025). Genomic surveillance capacity has historically been limited, though improving (e.g. Africa CDC initiatives); strengthening pathogen sequencing is cited as a continental priority (Amisu et al., 2024). Poor sanitation and waste disposal also heighten risks as outbreaks of cholera and other diseases are driven by poor environmental sanitation and contaminated water (Pate & Duneton, 2025). Low routine immunization coverage in many SSA countries leaves populations vulnerable to preventable diseases. Chronic political instability and conflict further undermine health systems (e.g. years of civil war destroyed infrastructure in Liberia/Sierra Leone & DRC (World Bank, 2025). Finally, heavy reliance on external donors amid shrinking aid strains sustainability of biosecurity programs (UNODA, 2024), and the high cost of advanced biosafety infrastructure (e.g. BSL-3 labs costing tens of millions USD) makes widespread implementation difficult. These factors together create a challenging biosecurity landscape in sub-Saharan Africa.

3.2 The Global Initiative to Prevent the Proliferation of Weapons and Hazardous Materials (2002)

The Global Partnership Against the Spread of Weapons and Materials of Mass Destruction (GP) is an international collaborative initiative established in 2002 to prevent the proliferation of chemical, biological, radiological, and nuclear (CBRN) weapons and related materials. It serves as a cooperative framework for countries to strengthen global security through capacity building, threat reduction, and the promotion of safe management of hazardous materials.

3.2.1 Past, Present, and Future

The Global Partnership (GP) was established during the 2002 G8 Summit in Kananaskis, Canada, with the primary objective of preventing terrorist groups and their affiliates from acquiring weapons of mass destruction (WMD), related materials, or delivery systems.
The initiative encouraged additional nations to participate by endorsing six core principles focused on preventing terrorist access to WMDs and nine operational guidelines designed to guide the development and expansion of cooperative threat reduction programs.
Since its inception, the Global Partnership has expanded to include 31 active member countries and continues to deliver a wide range of global initiatives structured around four key priority areas:

- Enhancing nuclear and radiological security;
- Mitigating biological threats;
- Promoting chemical weapons destruction and security; and
- Supporting the implementation of United Nations Security Council Resolution (UNSCR) 1540.

Strategic discussions on program priorities and ongoing initiatives take place during the biannual Global Partnership Working Group meetings, supported by four specialized sub-working groups each addressing nuclear and radiological security, biological security, chemical security, and UNSCR 1540 implementation. The chairmanship of the Partnership rotates annually, aligning with the G7 Presidency.

Following the 2008 Global Threat Reduction mandate, the GP broadened its global operations to prevent the development or acquisition of chemical, biological, radiological, and nuclear (CBRN) weapons by terrorist entities. To achieve this, the Partnership focuses on activities such as securing and eliminating hazardous materials, safe-guarding vulnerable infrastructure, reinforcing international security networks, and supporting multilateral initiatives including the Nuclear Security Summit (NSS) and the Global Health Security Agenda (GHSA). Furthermore, it assists partner countries in fulfilling international obligations under UNSCR 1540, which aims to curb the proliferation of WMDs.

3.2.2 Global Partnership Working Group

Members of the Global Partnership (GP) engage in continuous coordination and collaboration to design and implement initiatives that address the diverse threats associated with chemical, biological, radiological, and nuclear (CBRN) weapons and related materials. Under the leadership of the rotating G7 Presidency, GP member states convene twice annually as part of the Global Partnership Working Group (GPWG). These meetings serve to evaluate ongoing progress, analyze emerging global threats, and identify effective strategies for preventing terrorist organizations and high-risk actors from acquiring or deploying weapons of mass destruction. The GPWG operates through four specialized sub-working groups, each fostering expert-level dialogue and cooperation in specific thematic areas:

- Biological Security Working Group (BSWG)
- Chemical Security Working Group (CSWG)
- CBRN Working Group (CBRNWG)
- Nuclear & Radiological Security Working Group (NRWSG)

3.2.3 Global Partnership Principles

The Global Partnership (GP) operates under a set of six foundational principles that guide its activities and international collaborations.

1. Promote and strengthen international frameworks: Encourage the adoption, universal ratification, and effective enforcement of multilateral treaties and international mechanisms aimed at preventing the proliferation or illicit acquisition of weapons of mass destruction (WMD) and related materials, while reinforcing the institutions responsible for their implementation.
2. Ensure accountability and security of sensitive materials: Establish and maintain robust systems to track and secure relevant materials throughout their production, utilization, storage, and transport both domestically and internationally and provide technical and financial support to states lacking the necessary capacity.
3. Enhance facility protection and resilience: Implement and sustain effective physical protection strategies, including multi-layered security (“defense-in-depth”) measures, for facilities handling hazardous or sensitive materials, and assist resource-constrained states in strengthening the security of such installations.
4. Strengthen border security and international collaboration: Improve border control systems, law enforcement mechanisms, and cross-border cooperation to detect and prevent the illicit trafficking of CBRN materials. This includes deploying detection technologies, training customs and security personnel, and sharing intelligence to track and intercept unauthorized transfers, while assisting states that require capacity-building support.
5. Develop and enforce export and transshipment controls: Establish and periodically review national export and transshipment control systems covering items listed on multilateral control regimes as well as dual-use goods that may contribute to WMD

development. This entails addressing end-user verification, brokering regulations, and “catch-all” provisions, and supporting states that lack the legal, regulatory, or technical infrastructure to implement such controls.
6.Safely manage and reduce dangerous stockpiles: Advance initiatives aimed at the secure management and elimination of fissile materials no longer needed for defense purposes, the complete destruction of chemical weapons, and the minimization of stocks of hazardous biological agents and toxins recognizing that the overall threat of terrorist access decreases as global quantities of these materials are reduced.

3.3 UNSCR 1540: UN SECURITY COUNCIL RESOLUTION 1540 (2004)

The United Nations Security Council Resolution (UNSCR) 1540, adopted unanimously on 28 April 2004, addresses the global challenge of non-proliferation of weapons of mass destruction (WMD). Acting under Chapter VII of the United Nations Charter, the resolution mandates all UN Member States to establish and enforce comprehensive legal, regulatory, and administrative frameworks to prevent the proliferation of chemical, biological, radiological, and nuclear (CBRN) weapons and their delivery systems. A central objective of the resolution is to prevent non-state actors, including terrorist groups, from developing, acquiring, or using such weapons and materials.

The three main obligations created by the resolution are:
1.To "refrain from providing any form of support to non-State actors that attempt to develop, acquire, manufacture, possess, transport, transfer or use nuclear, chemical or biological weapons and their means of delivery." (Article 1)
2.To "adopt and enforce appropriate effective laws which prohibit any non-State actor to manufacture, acquire, possess, develop, transport, transfer or use nuclear, chemical or biological weapons and their means of delivery". (Article 2)
3.To "take and enforce effective measures to establish domestic controls to prevent the proliferation of nuclear, chemical, or biological weapons and their means of delivery". (Article 3)
The resolution also underscores the ongoing significance of non-proliferation and disarmament treaties, and mandates the establishment of a committee (the 1540 Committee) to monitor its implementation. Member States are urged to submit reports to the 1540 Committee detailing their current status and strategies regarding the commitments outlined in the resolution within six months of its adoption; however, in practice, many States required considerably more time to comply. The 1540 Committee was intentionally established without enforcement or sanctioning authority. Although UN Security Council Resolution 1540 is legally binding on all UN Member States, its implementation emphasizes cooperation, assistance, and voluntary participation rather than punitive measures. Regionally coordinated strategies have proven particularly effective in enhancing national implementation efforts. To oversee progress, the UN Security Council created a subsidiary body the 1540 Committee responsible for monitoring and reporting on the resolution’s implementation. On 30 November 2022, through Resolution 2663 (2022), the Security Council extended the Committee’s mandate for ten years, until 30 November 2032. The United Nations Office for Disarmament Affairs (UNODA) 2022 supports the Committee’s operations and facilitates
•Supporting national implementation, including regionally harmonized approaches;
•Enhancing cooperation among international, regional, and subregional organizations; and
•Strengthening partnerships with key stakeholders, such as civil society, the private sector, and academia.

3.4 The International Health Regulations (2005)

The International Health Regulations (IHR) are binding international agreement that covers measures for preventing the transnational spread of infectious diseases. It introduces critical protective measures to protect the rights of travelers and other persons in relation to the handling of personal information, informed consent, and equality of treatment in the application of health interventions. The IHR were adopted by the 58th World Health Assembly in 2005 via Resolution WHA58.3. They establish the legal structure that, alongside other considerations, sets national core readiness to address acute public health incidents of possible or current local and international significance, including at transit entry points.

The percentage attribute of the IHR is characterized by thirteen primary competencies that have been attained at a designated timeframe. These include

(1) National regulatory, strategic, and financial mechanisms
(2) Coordination frameworks and focal point interactions;
(3) Surveillance;
(4) Response;
(5) Preparedness;
(6) Risk communication;
(7) Human resources;
(8) Laboratory;
(9) Points of entry;
(10) Zoonotic events;
(11) Food safety;
(12) Chemical events;
(13) Radio-nuclear emergencies.

The International Health Regulations (IHR) constitute a global legal framework that is binding on 196 nations, including the 194 Member States of the World Health Organization (WHO). They establish rights and responsibilities for countries, such as the obligation to report public health events. The Regulations further define the parameters for determining whether a particular occurrence qualifies as a Public Health Emergency of International Concern (PHEIC). The charge of implementing the IHR rests upon all States Parties that are governed by the Regulations and on WHO, which then plays the role of coordination in IHR implementation and, together with its partners, supports countries in strengthening capacities.

The IHR requires that all countries have the ability to identify critical public health situations in a timely manner, ensuring that surveillance systems are in place to do so. Secondly, evaluate and document using the decision framework of the IHR to identify public health public health occurrences and notify the WHO through their National IHR Focal Point those that may constitute a public health emergency of international concern. Lastly, address public health threats and crises.

The establishment of coherent policies, standardized procedures, and the operational and technical capabilities mandated by the IHR (2005) will facilitate early detection and effective international coordination in managing biological events, whether they arise naturally or are intentionally caused, thereby enhancing national health security. Laboratory-based monitoring and outbreak identification are fundamental for the prevention and control of biological hazards. Moreover, the effectiveness of laboratory systems relies on the application of biosafety and biosecurity standards, reinforced by a robust and supportive legal and regulatory framework.

3.5 The Global Health Security Agenda (2014)

The Global Health Security Agenda (GHSA), established in February 2014, is an international initiative designed to enhance global capacity to prevent, identify, and respond to infectious disease threats. It represents a cross-sectoral collaboration involving over 100 nations, non-governmental entities, private industry partners, and international bodies, all working collectively to strengthen health security capabilities through coordinated multisectoral efforts and clearly defined, measurable objectives. The GHSA employs a "One-Health" approach, recognizing the interconnectedness of human, animal, and environmental health to prevent and control outbreaks. One Health represents a comprehensive and integrative framework that seeks to achieve a sustainable balance in optimizing the well-being of humans, animals, and ecosystems. Although areas such as health, food, water, energy, and the environment encompass distinct sectoral priorities, cross-sectoral and interdisciplinary collaboration plays a critical role in safeguarding health, tackling issues like emerging infectious diseases, antimicrobial resistance, and food safety, and in maintaining the resilience and sustainability of ecosystems.
To promote global security against emerging threats from infectious diseases and strengthen the focus on global health security across both regional and national contexts, the Global Health Security Agenda was established in 2014. Numerous issues that are specific to each nation have weakened its ability to mitigate, identify, and effectively respond to emerging infectious disease outbreaks. To meet specific and quantifiable targets related to biological threats, as well as the core competencies mandated by the World Health Organization (WHO), the World Organization of Animal Health (OIE), Joint External Evaluation (JEE Performance of Veterinary Services Pathway (PVS), International Health Regulations (IHR), and other pertinent global health security frameworks, GHSA currently facilitates a variety of capacity-building efforts through a partnership of countries, global institutions, and key non-governmental stakeholders. Currently, 26 SSA countries are members of the GHSA: Burkina Faso, Cameroon, Congo DRC, Côte d'Ivoire, Ethiopia, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Liberia, Madagascar, Malawi, Mali, Namibia, Nigeria, Republic of the Congo, Rwanda, Senegal, Sierra Leone, South Africa, Tanzania, Togo, Uganda, Zambia, Zimbabwe.

CHAPTER FOUR: INTERNATIONAL HEALTH REGULATIONS AND THE GLOBAL HEALTH SECURITY AGENDA

4.0 Biosecurity and Biosafety as a Component of the Global Health Security Agenda

Disease outbreaks have the capacity to significantly impact global security by undermining national economies, disrupting international travel and trade, endangering public health and safety, and diminishing citizens' trust in their governments (SEC, 2011). Factors such as increased global mobility and commerce, rapid urban expansion, the growing interest of terrorist groups in weapons of mass destruction (WMDs), and advancements in technologies capable of creating or manipulating pathogens with pandemic potential collectively heighten the risk of a large-scale biological crisis (Larwanou, 2011). Because infectious diseases transcend national borders, ensuring robust and comprehensive biosafety and biosecurity is a shared global obligation to prevent the unlawful acquisition, loss, theft, misuse, diversion, or deliberate release of biological agents and toxins. Despite efforts led by initiatives such as the Global Partnership Against the Spread of Weapons and Materials of Mass Destruction and the Global Health Security Agenda (GHSA), approximately 69% of assessed countries still lack adequate biosecurity capacity (Larwanou, 2011).

4.1 Africa Centre for Disease Control (Africa CDC) Initiative to Promote Biosecurity and Biosafety in Africa.

The Africa CDC launched its Biosafety and Biosecurity Initiative (BBI) in April 2019 to strengthen biosecurity and biosafety systems across African Union Member States by developing regional frameworks, building professional capacity, and supporting the establishment of regulatory standards for managing high-risk pathogens. This initiative is supported by partners such as the Nuclear Threat Initiative (NTI), Global Affairs Canada, and other bilateral donors that provided initial catalytic funding for strategy development, training programs, and laboratory system strengthening. While early investments were significant, most of the financing has been project-based and donor-driven rather than long-term institutional funding, raising concerns about the sustainability of key activities once external funding cycles conclude (NTI, 2019).

Africa remains highly vulnerable to devastating infectious disease outbreaks due to its expanding urban populations, persistent infectious disease burdens, and systemic weaknesses in public health infrastructure. In response, the Africa CDC has taken a leading role in building a coordinated continental architecture for biosafety and biosecurity. The BBI has achieved notable progress, especially after the COVID-19 pandemic intensified global attention on health security. Member States working through the Africa CDC and with regional and international partners have advanced the harmonization of laboratory safety standards, expanded workforce training, and improved regional coordination.
According to the Africa CDC's (2021) BBI 2021–2025 Strategic Plan, the initiative emphasizes context-specific national priorities and calls for consistent minimum training, certification, and regulatory standards across all African Union countries. The Strategic Plan is

viewed as a replicable model for strengthening regional collaboration in health emergency preparedness and response. However, significant gaps remain. These include:

- Inadequate sustainable funding, with heavy reliance on external donors and limited domestic budget allocations.
- Uneven implementation of biosafety and biosecurity legislation across Member States.
- Insufficient workforce capacity, especially in rural and fragile health systems.
- Limited national regulatory oversight for high-risk pathogens and dual-use research.
- Inconsistent reporting and transparency mechanisms, including low participation in Confidence-Building Measures under the Biological Weapons Convention.

Strengthening domestic financing, institutionalizing regulatory frameworks, and building long-term regional training infrastructure remain essential for sustaining the gains made under the BBI.

Protecting people from exposure to biologically toxic materials and ensuring safe storage and use remains weak across most African countries: WHO Joint External Evaluations (2016–2019) put the continent's average biosafety/biosecurity capacity at about 32% (40 of 47 countries undertook JEE during that period) and the 2021 Global Health Security Index found the African average overall GHS score very low (29/100). In the GHSI assessments of AU Member States, none of the participating countries scored above 50% on biosecurity and only two scored ≥50% on biosafety, indicating the majority of countries lack adequate industrial, environmental, and laboratory protections.

The Africa CDC launched the Biosafety and Biosecurity Initiative (BBI) in 2019 to address growing concerns surrounding hazardous pathogens, especially as the COVID-19 pandemic dramatically expanded testing and research facilities across the continent. This rapid scale-up highlighted the urgent need to strengthen biosafety and biosecurity systems to safeguard public health and mitigate economic disruption from biological threats.

The initiative is structured around five principal components:

1. Formulating a model legal and regulatory framework for biosafety and biosecurity.
2. Establishing and operationalizing five multidisciplinary Regional Technical Working Groups (TWGs) comprising sectoral and subject-matter experts.
3. Designing and implementing a regulatory and accreditation system for institutions handling high-risk pathogens and toxins.
4. Developing and launching a Regional Training and Certification Programme (RTCP) to build a competent biosafety and biosecurity workforce.
5. Strengthening national public health institutes and reference laboratories to detect, identify, and respond to biological threats.

The framework is aligned with the International Health Regulations (IHR 2005), the Biological Weapons Convention (BWC), and

relevant UN Security Council resolutions. It guides countries on designating a lead biosafety authority, developing national standards, and conducting biological risk assessments. Africa CDC has also produced an advocacy and communication plan to help mobilize political and public commitment.

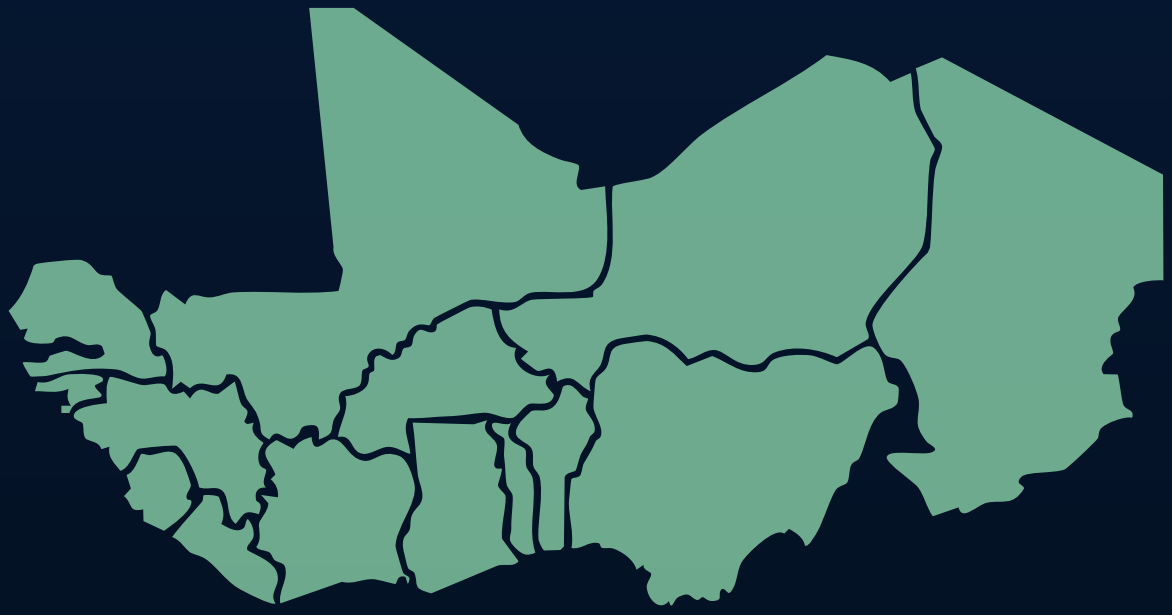
Since the rollout of the 2021–2025 BBI Strategic Plan, notable progress has been recorded. The model legal framework has been drafted and piloted with several member states, supporting their efforts to update or create national biosafety and biosecurity laws. Regional TWGs are now functional across all five AU regions, facilitating country engagement and harmonization of priorities. The RTCP has trained hundreds of laboratory personnel, biosafety officers, and regulators, with standardized curricula now adopted by several national public health institutes. Additionally, Africa CDC has begun developing an assessment and accreditation mechanism for high-risk pathogen facilities, contributing to improvements in laboratory safety practices.

Despite these achievements, the initiative faces challenges, including uneven national commitment, limited financing for implementation, language and governance diversity across AU member states, and gaps in skilled personnel particularly in francophone and lusophone regions. The COVID-19 response also revealed persistent weaknesses in laboratory infrastructure, supply chain systems, and regulatory oversight for emerging technologies such as genomic sequencing.

Key lessons learned include the importance of sustained political will, the need for localized capacity building rather than reliance on external expertise, and the value of regional coordination in aligning diverse countries around common biosafety and biosecurity goals. The multi-stakeholder consultations held across all subregions proved essential in ensuring that the legal framework reflects Africa-specific realities rather than externally imposed standards.

Overall, the BBI has created a continent-wide, country-led roadmap that brings together international partners, regional bodies, and national governments. It now serves as a benchmark for strengthening biosafety and biosecurity preparedness and enhancing Africa's resilience to current and future biological threats.

CHAPTER 5: ASSESSMENT OF BIOSECURITY CAPABILITIES IN WEST AFRICA



5.0 Current Status of Biosecurity and Biosafety in West Africa

West Africa is a heterogeneous subregion of 16 countries including Benin, Burkina Faso, Cabo Verde, The Gambia, Ghana, Guinea, Guinea-Bissau, Côte d'Ivoire, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone, and Togo. All recognized by the United Nations as a distinct geopolitical bloc. The region's ecological diversity, shaped by the Sahara and the Atlantic coastline, supports rich biodiversity and underscores the importance of robust biosafety and biosecurity systems.

Overall, biosafety and biosecurity capacity across West Africa is shaped by existing national frameworks, though many countries face persistent challenges related to implementation gaps, limited financing, insufficiently trained personnel, and inadequate laboratory infrastructure. Regional institutions particularly the Africa CDC, ECOWAS, and WAHO continue to drive harmonized strategies, workforce development, and certification initiatives to close these gaps.

At least five countries (Burkina Faso, Ghana, Nigeria, Senegal, and Togo) have established biosafety and biosecurity legislation or policy frameworks, and several others are in the process of updating regulations, including provisions for emerging technologies such as genome editing. As of 2023, approximately four to five countries in the region operate at least one BSL-2 or BSL-3 laboratory, supporting surveillance, diagnostics, and research on high-priority pathogens (e.g., Ebola, Lassa fever).

Countries with comparatively stronger systems include Nigeria, Senegal, Burkina Faso, and Togo, all of which regularly participate in regional initiatives on Biosafety and Biosecurity (BSBS) and Biological Weapons Convention (BWC) implementation. Before presenting the selected country descriptions and their Joint External Evaluation (JEE) scores in Table 7, it is important to note that the remaining West African nations including Benin, Cabo Verde, The Gambia, Guinea, Guinea-Bissau, Côte d'Ivoire, Mali, Mauritania, Niger, Sierra Leone, and Ghana also demonstrate varying levels of preparedness, with ongoing efforts to strengthen laboratory governance, legislative frameworks, and emergency response systems.

5.1 Nigeria Biosafety and Biosecurity Overview

Nigeria's biosecurity and biosafety framework is led by the National Biosafety Management Agency (NBMA), established under the 2015 Act to regulate genetically modified organisms (GMOs) and modern biotechnology in line with the Cartagena Protocol on Biosafety and the Biological Weapons Convention (BWC). The framework addresses both biosafety risks (accidental releases) and biosecurity threats (intentional misuse). Key policy instruments include the National Biosafety Policy and the National Biosecurity Policy and Action Plan (2022–2026), which coordinates stakeholder actions on risk assessment, capacity building, and public awareness. Capacity-strengthening initiatives are supported through national training programs, the Youth for Biosecurity initiative, the EU-supported National Preparedness Programme, and technical assistance from UNODA and the BWC Implementation Support Unit. Nigeria has approved two GM food crops: pod-borer resistant (PBR) cowpea in 2019 and TELA maize in January 2024, authorized by NBMA and the National Committee on Naming, Registration and Release of Crop Varieties, respectively.

TABLE 2: NIGERIA BIOSAFETY AND BIOSECURITY CHALLENGES AND RECOMMENDATIONS

Thematic Areas	Gaps / Challenges	Recommended Actions
Operational	• Limited rapid response capacity for biological incidents and outbreaks. • Weak multisectoral coordination during emergencies. • Poor laboratory inventory management and tracking of high-risk pathogens.	• Establish and operationalize multisectoral biosafety and biosecurity emergency response mechanisms. • Develop and routinely test national and subnational bio preparedness and bioterrorism response plans. • Implement national laboratory inventory and pathogen accountability systems to reduce risks of loss, theft, or
Human Resources	• Insufficient number of trained biosafety, biosecurity, and outbreak response personnel. • Limited continuous professional development for laboratory and frontline health workers.	• Scale up training and retention of skilled biosafety, biosecurity, and public health professionals. • Institutionalize continuous capacity-building programmes for laboratory staff, clinicians, veterinarians, and environmental health officers.
Governance	• Weak implementation of existing biosafety and biosecurity policies. • Inadequate and inconsistent funding for biosecurity programmes. • Fragmented institutional roles and responsibilities.	• Strengthen governance frameworks with clear leadership, defined institutional mandates, and accountability mechanisms. • Ensure sustainable financing for biosafety and biosecurity through dedicated budget lines. • Enhance inter-ministerial and inter-agency coordination

Thematic Areas	Gaps / Challenges	Recommended Actions
Perception of Risk & Community Engagement	• Low public awareness and understanding of biosecurity risks. • Limited community participation in preparedness and response efforts. • Mistrust and misinformation during health emergencies.	• Low public awareness and understanding of biosecurity risks. • Limited community participation in preparedness and response efforts. • Mistrust and misinformation during health emergencies.
Zoonotic & Environmental Interface (One Health)	• High risk of zoonotic disease transmission due to environmental degradation and large human–animal interfaces. • Weak integration of animal, human, and environmental health surveillance systems.	• High risk of zoonotic disease transmission due to environmental degradation and large human–animal interfaces. • Weak integration of animal, human, and environmental health surveillance systems.
Security Sector Engagement	• Limited involvement of security agencies in biosafety and biosecurity planning and enforcement. • Weak protection of high-risk biological materials and facilities.	• Limited involvement of security agencies in biosafety and biosecurity planning and enforcement. • Weak protection of high-risk biological materials and facilities.

5.2 Senegal Biosafety and Biosecurity Overview

Even though Senegal has ratified the international agreement on BWC, there is currently no formal memorandum of understanding or established framework between national public health agencies and security bodies. Certain national operations are carried out on an informal basis, suggesting that the institutionalization of national systems for preparedness and response to significant public health emergencies under the International Health Regulations (IHR, 2005) remains necessary. Senegal modernized its biosafety framework by enacting a new law on 14 June 2022, replacing the 2009 law, to facilitate the controlled use of genetically engineered (GE) products while adhering to international commitments.

Senegal is recognized for maintaining a strong foundation in the prevention, detection, and response to public health threats. Recent initiatives demonstrate that the country is both capable and committed to enhancing and sustaining its capacities to respond more rapidly, efficiently, and effectively within the realm of health security. The country successfully contained its Ebola outbreak, but the event underscored the need to strengthen core capacities to better manage future epidemics, zoonotic infections such as highly pathogenic avian influenza, and other major public health emergencies. Despite being an associate of the Global Health Security Agenda (GHSA), Senegal does not yet possess a comprehensive, integrated framework for overseeing biosafety and biosecurity practices in laboratories. Act No. 2009-27, which established the National Biosafety Authority, remains the sole piece of biosafety legislation currently in force within the country.

TABLE 3: SENEGAL BIOSAFETY AND BIOSECURITY CHALLENGES AND RECOMMENDATIONS

Gaps / Challenges	Existing Strengths	Targeted Recommendations
Low public awareness and skepticism toward biotechnology (GM crops, genomic surveillance, vaccines, clinical trials) limiting uptake and participation	Presence of public health institutions, universities, and prior engagement with international research and donor-funded programs	Develop national risk communication and community engagement strategies on biotechnology; integrate biosafety awareness into public health, agricultural extension, and livestock trade outreach, especially in border and pastoral communities
Weak enforcement of biosafety and biosecurity regulations, particularly in aquaculture (poor fencing, waste disposal, and	Existing sectoral regulations and technical guidance; aquaculture sector already structured	Strengthen inspection, monitoring, and enforcement mechanisms; provide low-cost compliance tools and training for farmers; link enforcement to licensing and market access
Institutional fragmentation in biosafety and biosecurity governance	Multiple competent authorities already exist across health, agriculture, and environment sectors	Formulate and implement harmonized national policies to align and streamline biosafety and biosecurity institutions, clarifying mandates and coordination pathways
Persistent funding and preparedness gaps, despite international support	Ongoing international donor engagement and regional partnerships	Prioritize domestic budget lines for biosafety and biosecurity; leverage donor funding for long-term system strengthening rather than ad hoc projects
Infrastructural limitations affecting surveillance, laboratory testing, and waste management	Basic laboratory and surveillance platforms exist	Establish national guidelines and protocols to strengthen foundational capacities, including laboratory biosafety, waste management, and field biosecurity practices
High population mobility, transboundary livestock movement, and informal border trade increasing biosecurity risks	Senegal's participation in regional trade and ECOWAS frameworks	Integrate biosafety and biosecurity measures into border control systems, livestock movement regulation, and cross-border surveillance; enhance coordination between veterinary, public health, and border authorities

5.3 Sierra Leone Biosafety and Biosecurity Overview

Biosecurity and biosafety were previously underappreciated in Sierra Leone until the Ebola Virus Disease outbreak, which stimulated significant activity and attention, with a particular focus on promoting biosafety among health personnel. Initial laboratory work concentrated on research and reference laboratories. Currently, there is a limited integrated national system for biosafety and biosecurity, despite ratifying the international agreement on the BWC. There are insufficient mechanisms established to detect, store, safeguard, and track hazardous pathogens. However, there is effective ongoing coordination with the Infection Prevention and Control (IPC) program to tackle challenges related to healthcare-associated infections (HCAIs). Adequate biosecurity protocols have been implemented to reduce the risk of unauthorized removal or accidental release of biological agents at the Central Public Health Reference Laboratory (CPHRL) and the Lassa Fever Laboratory. The laboratory workforce generally shows limited awareness of international biosafety and biosecurity guidelines that promote safe and responsible operations, which is quite worrisome despite the dangerous dimensions that the EVD took in the country. The GHSA has introduced a strategic framework in Sierra Leone aimed at reinforcing and connecting international networks for real-time disease surveillance through investments in national surveillance systems built on the Integrated Disease Surveillance and Response (IDSR) approach and aligned with the International Health Regulations (IHR, 2005). The initiative also encourages data sharing in accordance with global agreements. Over a five-year period, GHSA's objective is to enhance core indicator- and event-based surveillance mechanisms capable of identifying occurrences of public health, animal health, and biosafety importance. These efforts are expected to strengthen coordination and information exchange across multiple sectors and between local, national, and international authorities, thereby advancing compliance with IHR core capacity requirements and World Organization for Animal Health (OIE) standards ((WOAH, 2025).

TABLE 4: SIERRA LEONE BIOSAFETY AND BIOSECURITY CHALLENGES AND RECOMMENDATIONS

Gaps / Challenges	Strengths	Recommendations
Limited oversight of pathogen-holding facilities with no national inventory or tracking system	Presence of public health and research laboratories with experience managing VHF and other priority pathogens	Enact and enforce comprehensive biosafety and biosecurity legislation mandating national pathogen inventories, reporting, and routine audits, with phased implementation to reflect funding realities
Absence of a national regulatory authority for laboratory licensing and oversight	Functional ministries and technical units within the health sector	Establish a national biosafety and biosecurity regulatory authority with clear mandates for licensing, accreditation, and compliance, using cost-efficient models and leveraging existing institutions
Gaps in biosafety guidelines with limited One Health integration (animal–human–environment)	Growing recognition of One Health following Ebola and zoonotic disease outbreaks	Develop standardized national biosafety and biosecurity guidelines integrating human health, animal health, livestock trade, wildlife handling, and population movement risks, particularly in border communities
Weak access control and physical security in regional laboratories due to infrastructure and funding constraints	Network of regional and peripheral laboratories supporting surveillance	Prioritize minimum access control standards (locks, logs, controlled entry) for regional labs through low-cost, risk-based upgrades and donor–government co-financing
Limited awareness and enforcement related to cross-border movement, livestock trade, and informal population	Existing border health posts and community-based surveillance experience	Integrate biosafety and biosecurity awareness into border health operations, livestock market oversight, and community engagement programs, focusing on risk communication rather than heavy infrastructure investment
Weak laboratory quality management systems	Previous exposure to laboratory strengthening initiatives	Implement the SLMTA program to improve laboratory quality, biosafety culture, and compliance, starting with national and regional reference laboratories

5.4 Ghana Biosafety and Biosecurity Overview

Ghana has the legal and regulatory framework for biosecurity known as the Biosafety Act, 2011 (Act 831), and the Biosafety (Management of Biotechnology) Regulations, 2019 (L.I. 2383). Other relevant acts include the Public Health Act, 2012 (Act 851), and the Environmental Protection Agency Act, 1994 (Act 490). These laws govern potential risks to animal and plant health, food safety, and the environment. The National Biosafety Authority (NBA) serves as the oversight body responsible for regulating the transfer, management, and utilization of genetically modified organisms (GMOs). The NBA also works with regulatory agencies and institutional biosafety committees certified by the Authority to ensure biosafety practices are implemented. The Health Facilities Regulatory Agency (HFRA) has the mandate to license and inspect health facilities, including clinical and biomedical laboratories, while the biosafety and biosecurity measures are incorporated in various laws and related measures, including the Health Institutions and Facilities Act. The National Action Plan for Health Security guides all health security strengthening efforts, a process informed by findings from evaluations, such as the JEE. Through the Integrated Disease Surveillance and Response (IDSR) system, Ghana meets its IHR requirements and participates in international assessments like the JEE to determine areas for improvement and steer policy planning.

TABLE 5: GHANA BIOSAFETY AND BIOSECURITY CHALLENGES AND RECOMMENDATIONS

Gaps / Challenges	Strengths	Recommendations
Porous borders and cross-border biosecurity risks (livestock trade, migratory herds, population movement)	Ghana's participation in ECOWAS and regional disease surveillance initiative	Strengthen cross-border surveillance through ECOWAS collaboration, including joint patrols, animal movement tracking, harmonized disease-control protocols, and enhanced border screening
Public skepticism toward biotechnology and GMOs	Active civil society, traditional leadership structures, and media networks	Implement targeted public education campaigns using trusted community leaders, media, and civil society to improve understanding of biotechnology safety
Weak coordination and limited funding for response systems	Existing inter-ministerial platforms and emergency response experience	Create a multisectoral coordination platform with dedicated budget lines to strengthen specimen referral systems and enable rapid joint outbreak response
Policy implementation gaps across sectors	Existence of national biosafety and biosecurity policies and regulatory frameworks	Strengthen enforcement through routine compliance audits, mandatory reporting, and clear accountability mechanisms across health, agriculture, environment, and border agencies
Human resource and laboratory infrastructure constraints	Presence of trained specialists in key national institutions and some functional laboratories	Invest in structured national capacity-building (train-the-trainer models) and targeted laboratory upgrades, including maintenance of BSCs and expansion of diagnostic coverage

5.5 Analysis of Baseline Biosecurity and Biosafety Capabilities Using WHO Joint External Evaluation (JEE) Scores for West African Countries

The WHO Joint External Evaluation (JEE) score is a cross-sectoral and jointly implemented voluntary process designed to evaluate progress toward meeting the objectives of the Global Health Security Agenda (GHSA). The GHSA Steering Committee established this autonomous evaluation mechanism to appraise each member nation's capacity for health security readiness, analyzing their capabilities to avert, identify, and respond promptly to public health hazards whether arising naturally, deliberately, or unintentionally. The JEE assists countries in identifying key weaknesses across their human, animal, and environmental health systems, allowing them to prioritize critical areas for capacity enhancement based on their respective scores. Furthermore, the JEE, as part of the International Health Regulations (IHR) Monitoring and Evaluation Framework, measures performance across 19 technical domains and 48 indicators, rated on a five-point Likert scale: 1 – No capacity, 2 – Limited capacity, 3 – Developed capacity, 4 – Demonstrated capacity, and 5 – Sustainable capacity. The assessment is structured around four overarching themes: Prevent – 7 technical areas and 15 indicators, Detect – 4 technical areas and 13 indicators, Respond – 5 technical areas and 14 indicators, Points of Entry (PoE) and Other IHR Hazards (chemical and radiological) – 3 technical areas and 6 indicators (see Table 6).

TABLE 6: JEE TECHNICAL AREAS AND CORRESPONDING EVALUATION INDICATORS

Technical areas	Number of indicators
Prevent	
National legislation, policy, and financing	2
IHR coordination, communication, and advocacy	1
Antimicrobial resistance	4
Zoonotic disease	3
Food safety	1
Biosafety and biosecurity	2
Immunization	2

Technical areas	Number of indicators
Detect	
National laboratory systems	4
Real-time surveillance	4
Reporting	2
Workforce development	3
Respond	
Emergency preparedness	2
Emergency response operations	4
Linking public health with security authorities	1
Medical countermeasures and personnel deployment	2
Risk communication	5

Technical areas	Number of indicators
Other IHR hazards and points of entry	
Points of entry	2
Chemical events	2
Radiation emergencies	2
Total	48

World Health Organization (2018), Joint External Evaluation Tool: Second Edition.

The IHR capacity levels are rated on a scale ranging from Level 1 (no established capacity) to Level 5 (sustained capacity). Biosafety and biosecurity are part of the 19 thematic areas assessed under the WHO Joint External Evaluation (JEE) framework. The key indicators used to assess these domains include:
(1) P.6.1 – A comprehensive, government-wide biosafety and biosecurity system established for human, animal, and agricultural facilities.
(2) P.6.2 – Availability and implementation of biosafety and biosecurity education, training, and operational practices.

5.6 West Africa WHO's Joint External Evaluation (JEE) IHR Core Capabilities Score

The Joint External Evaluation (JEE) scores for West African countries reveal persistent systemic weaknesses across the biosafety and biosecurity landscape, despite varying levels of investment and institutional development. Overall, the region demonstrates low-to-moderate capacity, with most countries scoring between 1 and 2 out of 5, indicating that frameworks, systems, and practices remain only partially functional or are still at early stages of development. A clear regional clustering pattern emerges: coastal countries such as Benin, Côte d'Ivoire, Ghana, Liberia, Senegal, Sierra Leone, and Togo consistently perform better, particularly in biosafety and biosecurity training and operational practices, while Sahelian and economically constrained states such as Niger, The Gambia, and Guinea-Bissau tend to have the lowest scores.

Across the board, Indicator 1 (whole-of-government biosafety and biosecurity systems) records slightly poorer performance than Indicator 2 (training and operational practices). This reflects a common regional challenge: although many countries have initiated trainings, guidelines, or ad hoc practices, the foundational policy and institutional architecture, national legislation, interagency coordination, designated authorities, and integrated oversight mechanisms remains weak or fragmented. Only about half the countries demonstrate modest progress in establishing system-wide biosafety and biosecurity structures, and none has reached a fully functional capacity (scores of 4–5).

These patterns carry important implications for regional health security. First, the uneven capacity distribution increases transboundary risks, especially given porous borders and shared ecological and zoonotic disease hotspots. Second, persistent gaps in governance, legislation, and integrated oversight weaken the ability to prevent accidental releases, manage laboratory waste, enforce secure laboratory practices, and detect deliberate biological threats. Third, the weak performance of key regional actors particularly Nigeria, which scores 1 on both indicators highlights a significant vulnerability, as the country's size, population, and laboratory network make it strategically important for regional preparedness (table 7). Overall, the JEE results underscore the urgent need for harmonized policy reforms, strengthened multisectoral coordination, improved laboratory waste management systems, and deeper engagement of the security sector in biosafety and biosecurity governance across West Africa

TABLE 7: BIOSAFETY AND BIOSECURITY COUNTRY JEE SCORES FOR WEST AFRICAN COUNTRIES

Country	Indicator 1 (Whole-of-government biosafety and biosecurity system in place for human, animal, and agriculture facilities)	Indicator 2 (Biosafety and biosecurity training and practices)	Average score
Benin	2	2	2
Burkina Faso	1	2	1.5
Gambia	1	1	1
Ghana	2	2	2
Guinea	2	2	2
Guinea Bissau	1	1	1
Ivory Coast	2	2	2
Liberia	2	2	2

Country	Indicator 1 (Whole-of-government biosafety and biosecurity system in place for human, animal, and agriculture facilities)	Indicator 2 (Biosafety and biosecurity training and practices)	Average score
Mali	1	2	1.5
Mauritania	1	2	1.5
Niger	1	1	1
Nigeria	1	1	1
Senegal	2	2	2
Sierra Leone	2	2	2
Togo	2	2	2
Region Average	1.5	1.7	1.6

(WHO). (JEE) Mission Reports for West African countries, 2016–2021
Scoring Scale: 1 – No capacity; 2 – Limited capacity; 3 – Developed capacity; 4 – Demonstrated capacity; 5 – Sustained capacity

5.7 GHS Index Biosecurity & Biosafety Scores in Sub-Saharan Africa (2021)

The 2021 Global Health Security Index assigns each country a Biosecurity score and a Biosafety score (both ranging from 0 to 100). Sub-Saharan African countries generally score very low on these indicators. For example, Nigeria achieved a biosecurity score of only 24 (and 0 in biosafety), while Ghana scored 0 in biosecurity and 50 in biosafety. Cabo Verde, Burkina Faso, and Niger are the West African countries that scored zero on both measures. Only a few countries had non-zero scores: Senegal (biosecurity 15, biosafety 23), Mali (biosecurity 15, biosafety 22), Liberia (biosecurity 13, biosafety 20), Togo (biosecurity 12, biosafety 19), The Gambia (biosecurity 13, biosafety 20), Mauritania (biosecurity 15, biosafety 22), and a few others.

TABLE 8: 2021 GHS INDEX BIOSAFETY AND BIOSECURITY SCORES FOR WEST AFRICA (HIGHER IS BETTER).

Country	Biosafety Score	Biosecurity Score	Biosafety law	National BSBS Authority	BSL-3 Laboratory
Nigeria	0%	24%	Yes	Yes	Yes
Senegal	23%	15%	Yes	Yes	Yes
Mali	22%	15%	Yes	Yes	Yes
Ghana	50%	0%	Yes	Yes	Yes
Liberia	20%	13%	Yes	Yes	No
Togo	19%	12%	Yes	Yes	No
The Gambia	20%	13%	No	No	No
Burkina Faso	0%	0%	Yes	Yes	Yes

Country	Biosafety Score	Biosecurity Score	Biosafety law	National BSBS Authority	BSL-3 Laboratory
Mauritania	22%	15%	No	Partial	No
Niger	0%	0%	No	authority	No
Benin	19%	13%	Yes	No	No
Sierra Leone	20%	13%	Partial	Yes	No
Guinea-Bissau	27%	18%	No	Partial	No
Cape Verde	0%	0%	No	authority	No
Côte d'Ivoire	0%	4%	Yes	No	Yes
Average	16.1%	10.3%			

Source: GHS Index 2021 data)

Based on the 2021 assessment, West African countries recorded average scores of 16.1% in biosafety and 10.3% in biosecurity, as shown in Table 8 above, reflecting a notable improvement from the 2019 evaluation, where both averages stood at 0% and 2.7%, respectively. By comparison, the 2021 global averages were 18.6 for biosecurity and 20.9 for biosafety (ghsindex.org).

The data presented in table 4 highlight a consistent pattern of low-to-moderate biosafety and biosecurity capacity across West African countries. While some countries show incremental progress in establishing policies, laboratory systems, or training programs, the region remains characterized by uneven capacity, fragmented governance, and limited high-containment laboratory infrastructure. A clear geographic pattern is visible: coastal and more economically diversified countries such as Ghana, Côte d'Ivoire, Senegal, Liberia, Togo, and Sierra Leone tend to perform slightly better across indicators, while Sahelian countries (Niger, Burkina Faso, Mali, Mauritania) and small-state systems (The Gambia, Guinea-Bissau, Cabo Verde) show consistently weaker performance.

These results carry three major implications for the rest of the document:

1.Systemic weaknesses persist: Low scores on whole-of-government biosafety and biosecurity systems suggest that many countries still lack foundational legislation, oversight mechanisms, integrated national authorities, and sustainable financing.

2.Laboratory and operational gaps increase health security risks: Limited BSL-3 capacity, poor laboratory waste management, unclear governance structures, and insufficient security-sector engagement heighten vulnerability to accidental exposures, zoonotic spillover, and deliberate misuse.

3.Regional coordination is essential: Because West Africa depends heavily on cross-border movement for trade, migration, and livestock movement, uneven country performance represents a shared regional risk. This underscores the need for ECOWAS-wide harmonization, cross-border surge capacity, and joint biosafety/biosecurity strengthening programs.

CHAPTER 6: BIOSAFETY AND BIOSECURITY PROGRESS IN EAST AFRICA

6.0 Biosafety and Biosecurity in East Africa

The East African region is a diverse area in sub-Saharan Africa, comprising Kenya, Uganda, Tanzania, Rwanda, Burundi, South Sudan, and the Democratic Republic of the Congo as a members of the East African Community. A broader geographic definition, or the UN's geographic scheme, encompasses countries extending from the Horn of Africa southward to the Mozambique Channel. The region is known for its plateaus and the prominent East African Rift System. Biosecurity efforts in East African countries, under the Africa CDC's Biosafety and Biosecurity (BBI) Initiative and related programs like the Signature Initiative to Mitigate Biological Threats (SIMBA), focus on enhancing national capabilities to prevent, detect, and respond to biological threats through infrastructure development, training, policy reform, and cross-sector collaboration under a One Health approach. While Kenya, Uganda, and Tanzania are all important actors in East Africa's biosafety and biosecurity landscape, Kenya stands out for having a more fully developed statutory and institutional framework most notably the Biosafety Act (2009) which established the National Biosafety Authority and a formal, science-based regulatory process for GMOs and related biosafety matters coupled with strengthened laboratory capacity such as nationally recognized BSL-3 facilities at institutions like KEMRI that support advanced pathogen work and accreditation efforts (Kenya, 2009). Uganda has made clear, concrete progress in recent years through its National Biosafety Act (2017) and the establishment of a National Biosafety Committee and other implementing structures, and it likewise hosts high-containment laboratories (for example at Makerere/UVRI) used for TB and other priority pathogen work, showing steady movement from policy toward operational capacity. Tanzania possesses a long-standing National Biosafety Framework and accompanying regulations (dating back to mid-2000s/2009) that align with Cartagena Protocol obligations and provide important regulatory mechanisms, but compared with Kenya it has had a slower trajectory toward the kind of consolidated, updated national authority and the recent high-containment, accreditation developments seen in Kenya hence the common characterization of Kenya as the regional leader, with Uganda and Tanzania progressing at different paces.

While Kenya, Uganda, Tanzania, and Rwanda are discussed in detail here, these four countries are highlighted because they are the only ones in East Africa with sufficiently documented statutory frameworks, designated national authorities, and verifiable high-containment laboratory capacity to support meaningful comparison. For other countries in the region such as Burundi, South Sudan, and the Democratic Republic of the Congo publicly available, up-to-date biosafety and biosecurity information remains limited or fragmented, making rigorous analysis impossible without speculation.

6.1 Kenya’s Biosafety and Biosecurity Overview

Kenya's biosafety framework is anchored by the Biosafety Act 2009, which created the National Biosafety Authority (NBA) as the competent authority for overseeing the safe transfer, management, and utilization of genetically modified organisms (GMOs), as well as safeguarding human and animal health in the country. While the framework is primarily focused on biosafety, existing biosecurity measures are often integrated with general public health and biosafety issues. The current framework is primarily focused on biosafety, specifically Kenya was one of the earliest countries to ratify the Cartagena Protocol on Biosafety, which provides international guidelines for the safe use of GMOs and obliges signatory nations to develop regulatory frameworks and capacity for risk assessment. addressing the potential risks associated with GMOs throughout their lifecycle. The Biosafety Act is further operationalized by several specific regulations covering different aspects of GMO management, including contained use regulations (2011), environmental release regulations (2011), Import, Export, and Transit regulations (2011), and Labeling regulations (2012). Regarding biosecurity, Kenya's biosecurity laws are described as not being clearly defined and are often embedded within broader public health regulations rather than being a standalone system (Kenya, 2009).

TABLE 9: KENYA BIOSAFETY AND BIOSECURITY CHALLENGES AND RECOMMENDATIONS

Gaps / Challenges	Strengths	Recommendations
Ineffective implementation of existing biosecurity guidelines, largely confined to accredited laboratories	National biosecurity guidelines and laboratory manuals already exist	Digitalize and standardize biosecurity guidelines and mandate dissemination across all public and private health facilities
Limited awareness of biosecurity guidelines among non-accredited laboratories, border health posts, and veterinary services	Presence of trained laboratory professionals in accredited facilities	Expand biosecurity training and awareness programs to peripheral health facilities, border points, and livestock inspection services
Absence of a dedicated biosecurity regulatory authority, leading to weak oversight and	Existing health and veterinary regulatory institutions	Establish a dedicated national biosecurity regulatory body to coordinate oversight across human, animal, and environmental health sectors
Inadequate infrastructure and controls at porous borders, facilitating unregulated livestock trade and population movement	Strategic regional role in East African trade and disease surveillance networks	Integrate biosecurity protocols into border management systems, including livestock markets, transport corridors, and migrant entry points
Funding constraints limiting nationwide rollout of biosecurity systems and digital platforms	Ongoing donor engagement in health security and One Health initiatives	Leverage international health security and One Health funding to support digital dissemination, border infrastructure, and compliance monitoring

6.2 Uganda Biosafety and Biosecurity Overview

The National Biotechnology and Biosafety Policy (2008) laid the groundwork for the country to benefit from biotechnology and also provides a framework for the safe application of modern biotechnology while managing potential risks from GMOs. Uganda has been developing a national biosafety system to regulate the safe use of modern biotechnology, which culminated in the National Biosafety Act of 2017. In September 2025, the Uganda National Council for Science and Technology (UNCST) officially launched its 7th National Biosafety Committee (NBC) a collaborative initiative that brings together academia, research bodies, security institutions, regulatory agencies, and relevant government ministries. This partnership ensures that biotechnology advancement in the country is conducted safely, ethically, and in harmony with both national and international standards. Biosafety and biosecurity remain core components of Uganda's biotechnology governance structure, as weaknesses in these sectors could threaten public health, agriculture, and socio-economic stability. Collectively, these measures contribute to a holistic risk management system that upholds Uganda's adherence to domestic laws and global commitments, while fostering innovation, ethical accountability, public confidence, and national resilience.
Several acts contribute to Uganda's biosafety and biosecurity, including the:

- Anti-Terrorism Act (2002), which prohibit the research, production, and utilization of biological weapons within the country.
- National Environment Act (2019), which includes environmental protection measures related to hazardous wastes and GMOs.
- Public Health Act (1935, amended 2023), focusing on disease prevention and the public health system.
- Plant Protection and Health Act (2016), which includes import and export control measures for harmful organisms.
- The Occupational Safety and Health Act (2006) includes occupational safety and health measures related to hazardous materials.

The Uganda National Health Research Organization (UNHRO) oversees health research institutes. The Directorate for Biosafety (Ministry of Science, Technology, and Innovation) also works on education and training. The Biosafety and Biosecurity Association - Uganda (BBA-U) is another relevant body according to the International Federation of Biosafety Associations.
Uganda's biotechnology governance framework uses the Uganda National Council for Science and Technology (UNCST) to oversee biosafety and biotechnology, with interim measures including policies and guidelines from the National Biotechnology and Biosafety Bill (NBBA) and the National Science and Technology Act. While biosafety emphasizes preventing unintentional exposure to biological agents, biosecurity centers on avoiding their deliberate misuse or unauthorized access. National security in Uganda's framework is addressed by ensuring that these biosafety and biosecurity measures are robust enough to prevent threats such as bioterrorism and the misuse of biological agents, with efforts to create a comprehensive policy framework that integrates with broader national security goals.

TABLE 10: UGANDA BIOSAFETY AND BIOSECURITY CHALLENGES AND RECOMMENDATIONS

Gaps / Challenges	Strengths	Recommendations
High risk from porous borders, livestock trade, and population movement, increasing transboundary disease spread	Regional cooperation platforms (EAC, cross-border health initiatives)	Strengthen cross-border biosecurity coordination; integrate biosafety measures into animal movement control, border inspection, and community surveillance systems
Inadequate laboratory infrastructure, PPE, and biosafety-compliant facilities	Presence of central and regional laboratories	Prioritize phased upgrading of laboratories to minimum biosafety standards; allocate funds for PPE, waste management systems, and essential biosafety equipment
Low awareness and knowledge among professionals, policymakers, farmers, and the public, contributing to unsafe	Active community networks and extension systems	Implement targeted awareness campaigns for laboratory staff, livestock traders, border communities, and media; integrate biosafety messaging into animal health extension and migration-related outreach
Chronic funding constraints limiting laboratory systems, surveillance, training, and emergency preparedness	Government commitment to health security and One Health programming	Establish dedicated national budget lines for biosafety/biosecurity; prioritize donor and regional funding for border health security, laboratory strengthening, and cross-border disease surveillance
Weak enforcement of biosafety and biosecurity legislation due to poorly disseminated guidelines and inconsistent compliance across national and sub-national	Presence of an evolving regulatory framework and multisectoral institutions	Harmonize and update biosafety/biosecurity laws; strengthen enforcement mandates at border posts, local governments, and veterinary services; improve guideline dissemination and routine compliance monitoring

6.3 Ethiopia Biosafety and Biosecurity Overview

Ethiopia's biosecurity and biosafety framework is built on Biosafety Proclamation No. 655/2009 and its 2015 amendments (Biosafety Proclamation No. 896/2015), which regulate GMOs to protect human health and the environment. The Environmental Protection Authority (EPA) enforces this regulation, and the Ethiopian Public Health Institute (EPHI) oversees national laboratory guidelines. The framework also includes national biosafety and biosecurity guidelines for health laboratories, the establishment of the Ethiopian Biosafety and Biosecurity Association (EBBA) in 2023 to promote best practices, and the requirement for permits for high-risk biological agents. The framework has evolved, with revisions to the Biosafety Proclamation, such as the 2015 amendment that modernized definitions and reinforced the ministerial oversight framework. This continuous refinement aims to align Ethiopia's regulations with global standards and address emerging challenges in biotechnology.
The Environment, Forest, and Climate Change Commission has issued several directives to implement the 2015 Proclamation, covering areas like contained use and risk assessment. Articles in the Criminal Code address biosecurity by prohibiting weaponization of biological agents or toxins with penalties ranging from 5 to 15 years' imprisonment for offenders. Ministry of Health and Ethiopian Public Health Institute (EPHI): EPHI issues the Biosafety and Biosecurity Guidelines for Health Laboratories in Ethiopia to implement safety measures within the national laboratory system.

Furthermore, there are sector-specific regulations that enforce biosecurity in specific areas, including the Animal Diseases Prevention and Control Proclamation that Controls the import and export of biological products and pathological samples, and another is the Customs Proclamation that governs the import, export, and transit of restricted and prohibited goods, including some biological materials. “Although Ethiopia has a well-structured biosafety and biosecurity framework—anchored in the Biosafety Proclamations of 2009 and 2015, EPA oversight, EPHI laboratory guidelines, and sector-specific regulations—its implementation challenges mirror a broader regional pattern observed across Kenya, Uganda, and Rwanda. In all four countries, the existence of legislation and national frameworks has not translated into effective enforcement, consistent dissemination of guidelines, regular laboratory inspections, robust compliance monitoring, or strong accountability mechanisms. This reflects a wider systemic challenge in East Africa, where regulatory structures are established on paper but remain unevenly operationalized in practice.

TABLE 11: ETHIOPIA BIOSAFETY AND BIOSECURITY CHALLENGES AND RECOMMENDATIONS

Gaps / Challenges	Strengths	Recommendations
Inadequate laboratory infrastructure: Many clinical and public health laboratories lack functional biosafety cabinets, adequate PPE, appropriate facility layouts, and designated biosafety officers.	Existence of a national laboratory network and established public health institutions with experience in outbreak response.	Invest in upgrading laboratory infrastructure through the procurement and maintenance of functional BSCs, reliable PPE supply chains, and facility redesigns that meet biosafety standards; mandate the appointment and training of biosafety officers in all public laboratories.
Border misuse and limited control systems: Porous borders, high population movement, and informal livestock trade increase the risk of transboundary biological threats.	Presence of multisectoral actors across health, agriculture, customs, and security sectors.	Improve inter-agency coordination by harmonizing border screening and surveillance procedures, integrating animal and human health monitoring at points of entry, and deploying trained personnel along
Insufficient and inconsistent funding: Limited budget allocation for laboratory systems, workforce development, regulatory enforcement, and emergency preparedness; heavy reliance on short-term project funding.	Government recognition of biosafety and biosecurity as national priorities and existing partnerships with regional and	Establish sustainable national financing mechanisms through dedicated budget lines for biosafety and biosecurity; leverage regional and international funding (Africa CDC, WHO, FAO, World Bank, GHSA) to support multi-year, ring-fenced investments in infrastructure, workforce training, and preparedness systems.
Weak implementation of biosafety and biosecurity frameworks: Low public awareness, inconsistent enforcement, and limited operationalization of existing regulations.	Comprehensive legal and regulatory framework for biosafety and biosecurity is already in place.	Strengthen implementation through routine compliance audits, targeted awareness programs for laboratory staff and border officials, and standardized enforcement protocols across sectors.

6.4 Rwanda Biosafety and Biosecurity Overview

Rwanda's biosecurity and biosafety framework is structured around a recently enacted, comprehensive law governing biotechnology and genetically modified organisms (GMOs). A robust institutional framework supports this modern legislation, aligning it with international standards and protocols. The 2024 biosafety legal framework was Rwanda's first national biosafety law (Law No. 025/2024), which establishes a transparent, science-based regulatory process for all activities involving living modified organisms (LMOs) created through modern biotechnology, including research, import, export, and commercial release. The Rwanda biosafety legal framework's objectives are consistent with those of the Cartagena Protocol on Biosafety, to which Rwanda has been a party since 2004. This demonstrates the country's commitment to global safety standards for handling LMOs.

Other biosecurity legislations that cover or regulate other potential biological threats. Include Law No. 56/2018 relating to arms, which prohibits biological weapons.

Law No. 16/2016 on the protection of plant health.

Law No. 54 of 2008 on the prevention and fight against contagious diseases in domestic animals

Rwanda Biosafety and Biosecurity Organization (RBBO): Founded in 2020, this independent, professional organization supports the national framework by:

- Promoting biosafety and biosecurity standards.
- Providing training and professional development.
- Advising government ministries on policy.
- Coordinating quality control programs.

TABLE 12: RWANDA BIOSAFETY AND BIOSECURITY CHALLENGES AND RECOMMENDATIONS

Gaps / Challenges	Strengths	Recommendations
Insufficient trained human and technical capacity (biosafety officers, lab staff, inspectors, facility engineers)	Existing universities, research institutes, and training platforms	Establish structured national training and certification for biosafety professionals; integrate IPC, biosecurity, and lab risk management into pre- and in-service training across human and animal health sectors
Laboratory infrastructure gaps (uneven BSL-2+ distribution, lack of BSC certification, weak maintenance systems)	Growing public health and veterinary laboratory network	Develop national BSC testing and certification program; adopt standardized lab design and biosafety engineering guidelines; expand BSL-2+ labs in high-risk border and livestock trade regions
High cross-border population movement, informal livestock trade, and weak border controls increasing biological risk exposure	Established border health posts and animal health surveillance frameworks	Strengthen biosafety and biosecurity integration at border points; enhance surveillance along livestock trade routes; improve coordination between customs, animal health, public health, and security agencies
Low public awareness and misinformation on biosafety, biotechnology, and disease risks, especially in border and pastoral communities	Strong community structures, extension systems, and local leadership networks	Implement targeted risk communication in border zones and livestock corridors; use community leaders, radio, and extension workers; integrate biosafety messaging into animal health and migration-related outreach
Inadequate and fragmented funding for biosafety & biosecurity systems limiting laboratory upgrades, surveillance, and enforcement	Presence of national health, veterinary, and One Health coordination structures; engagement with international	Increase dedicated government budget lines for biosafety/biosecurity; leverage donor and PPP financing for labs and surveillance; integrate biosafety funding into health security, livestock, and border control programs

6.5 JEE of IHR Core Capacities Scores for Eastern African Countries

JEE biosafety and biosecurity scores for ten East African countries. The standout findings are that Ethiopia and Rwanda are the only countries with developed capacity, while South Sudan and Comoros perform worst, scoring 1/5 across both indicators (Table 13). Most other countries remain at limited capacity, with no country achieving demonstrated or sustainable capacity (scores 4–5). The pattern shows regional stagnation at low-to-mid capacity levels, with only two clear frontrunners.

TABLE 13: BIOSAFETY AND BIOSECURITY JEE SCORES FOR EAST AFRICAN COUNTRIES

Country	Indicator 1 (Whole-of-government biosafety and biosecurity system in place for human, animal, and agriculture facilities)	Indicator 2 (Biosafety and biosecurity training and practices)	Average score
Kenya	2	3	2.5
Uganda	2	2	2
Ethiopia	3	3	3
Tanzania	2	3	2.5
Burundi	2	2	2
South-Sudan	1	1	1
Eritrea	2	2	2
Comoros	1	1	1

Country	Indicator 1 (Whole-of-government biosafety and biosecurity system in place for human, animal, and agriculture facilities)	Indicator 2 (Biosafety and biosecurity training and practices)	Average score
Seychelles	2	2	2
Rwanda	3	3	3
Region Average	2	2.2	2.1

(WHO). (JEE) Mission Reports for East African countries, 2017–2023
Scores: 1 = No Capacity; 2= Limited capacity; 3= Develop capacity; 4 = Demonstrated Capacity; 5= Sustainable Capacity

6.6 GHS Index Biosecurity and Biosafety scores for East African countries

Based on the 2021 GHS assessment, East African countries recorded average scores of 18.6% in biosafety and 11.1% in biosecurity, as shown in Table 14 below. A significant increase was observed in the average score recorded in the 2019 evaluation of the region, with values reading 4.5% & 3.1% for biosecurity and biosafety, respectively. This increase could be attributed to the post-COVID-19 government strategic interventions aimed at boosting health facilities and enhancing International Health Regulations (IHR) frameworks, thereby promoting a resilient and better-certified level of preparedness against future pandemics.

TABLE 14: 2021 GHS INDEX BIOSECURITY AND BIOSAFETY SCORES FOR EAST AFRICAN COUNTRIES

Country	Biosafety Score	Biosecurity Score	Biosafety law	National BSBS Authority	BSL-3 Laboratory
Kenya	50%	0%	Yes	Yes	Yes
Uganda	18%	12%	Yes	Yes	Yes
Ethiopia	0%	24%	Yes	Yes	Yes
Tanzania	29%	19%	Yes	Yes	Yes
Burundi	0%	0%	No	No	No
South-Sudan	26%	15%	No	No	No
Eritrea	20%	13%	No	No	No

Country	Biosafety Score	Biosecurity Score	Biosafety law	National BSBS Authority	BSL-3 Laboratory
Comoros	0%	0%	No	No	No
Seychelles	23%	15%	No	No	No
Rwanda	20%	13%	Yes	Yes	Yes
Average	18.6%	11.1%			

(Source: GHS Index 2021 data)

East Africa shows strong sub-regional disparities, with Kenya, Uganda, Ethiopia, and Tanzania having the most established biosafety systems and high-containment labs, while Burundi, Comoros, Eritrea, South Sudan, and Seychelles remain at the lowest tier of biosafety and biosecurity readiness.

CHAPTER 7: CURRENT STATUS OF BIORISK OVERSIGHT IN CENTRAL AFRICA

7.0 Current Biosafety and Biosecurity Status in Central Africa

Biosecurity and biosafety capacity in Central Africa is improving through the Africa CDC's Biosafety and Biosecurity (BBI) Initiative, which supports national legislation, training, and laboratory infrastructure. The countries highlighted Gabon, Cameroon, DRC, CAR, and the Republic of Congo were selected because they are the only ones in the region with confirmed BSL-3 or BSL-4 laboratories and publicly verifiable biosafety/biosecurity capacities.

- Gabon: Hosts the region's strongest facility, the CIRMF BSL-4 lab, making it a major hub for high-risk pathogen research.
- Cameroon & DRC: Both operate BSL-3 laboratories supporting diagnosis and control of high-consequence pathogens.
- CAR & Republic of Congo: Also maintain BSL-3-level capacity, contributing to epidemic surveillance.

Other Central African countries (e.g., Chad, Equatorial Guinea, Angola, São Tomé & Príncipe) were not included because they lack verified BSL-3/4 labs, have limited biosafety legislation, or insufficient publicly available data.
Overall, only a few countries currently anchor the region's high-level biosecurity capacity, while the Africa CDC continues working to close gaps across the bloc

7.1 Gabon's Biosafety and Biosecurity Overview

Members of the Global Partnership (GP) engage in continuous coordination and collaboration to design and implement initiatives that Gabon has biosafety (GMO) regulations (GN No. 210 of 2016) that implement provisions regarding genetically modified organisms (GMOs), including environmental release, contained use, market placement, and labeling. In Gabon, various laws incorporate measures relevant to the control of activities involving biological agents and toxins. Article 106 of the Environmental Protection Law provides for the establishment of a list of dangerous substances, the development, storage, and transport of which are forbidden or require prior approval from the Ministry of Environment. In addition, Article 5 of Ordinance No. 10 of August 10, 2011, on the Pharmaceutical Sector, Article 3 of the Phytosanitary Oversight Law, and Article 3 of Order No. 106 of March 16, 2015, on Private Sanitary Structures, provide a framework for licensing related activities and facilities.

Gabon's biosecurity and biosafety framework is based on a multi-sectoral, "One Health" approach. However, it still struggles with challenges such as weak infrastructure, limited disease surveillance, and the high risk of diseases spreading from animals to humans. The country has put in place a basic framework to manage biological risks, with continued support from international partners like the World Health Organization (WHO and the Food and Agriculture Organization (FAO). Key components include the National Action Plan for Health Security (NAPHS) initiative, which aims to strengthen overall health security capabilities. Similarly, other initiatives include the One Health Approach and Animal biosecurity, which address the high risk of zoonotic diseases from its extensive forests. This involves multi-sectoral teams from environmental, agricultural, and public health services to monitor disease transmission between wildlife, domestic animals, and humans.

Furthermore, Gabon's 2014 Environmental Protection Act, which regulates the control of genetic resources, contains provisions for monitoring the importation and exportation of GMOs and other hazardous substances. Lastly, Gabon is one of the two African nations with a functioning BSL-4 research infrastructure (the Centre International de Recherches Médicales de Franceville (CIRMF), which studies wildlife ecology and pathogens to understand transmission mechanisms of pathogens better.

TABLE 15: GABON'S BIOSAFETY AND BIOSECURITY CHALLENGES AND RECOMMENDATIONS

Country Challenges (Gabon)	Recommendation
Zoonotic spillover from wildlife contact (logging, bushmeat, ape–human interface)	Strengthen One Health coordination, regulate wildlife trade, and scale risk-awareness programs at borders and communities
Weak infrastructure & limited funding for biosafety and labs	Upgrade labs via PPPs, innovative financing, and establish a national biosecurity management system with clear protocols.
Disease surveillance gaps (arboviruses, rural detection limits, low Yellow Fever coverage	Expand early warning systems (EMPRES-i/EMA-i), integrate CERMEL/CIRMF sequencing, intensify arbovirus surveillance and targeted YF
Border movement & livestock/wildlife trade risks	Improve border bio-surveillance, community awareness, and cross-border reporting mechanisms for zoonotic threats.
Fragmented One Health implementation	Create a high-level One Health coordination team, strengthen subnational rollout, secure sustained domestic funding, and integrate One Health into university

7.2 Cameroun’s Biosafety and Biosecurity Overview

In Cameroon, biosecurity and biosafety efforts have advanced from limited practices to formalizing regulations and guidance. Biosafety and biosecurity measures are incorporated into Law N°2003-2006, which regulates the safety of modern biotechnology in Cameroon, as well as the Laboratory Biosafety and Biosecurity Guidance in Cameroon, developed by the Ministry of Public Health. This guidance provides, among other aspects, for the classification of microorganisms by risk group, classification of laboratories, risk assessment processes, biosafety and biosecurity measures, training of personnel working in laboratories, and recommendations on biosafety, bioethics, and research for laboratory staff. In addition, Cameroon has a specific framework for genetically modified organisms, as outlined in Law N°2003-2006, which regulates the safety of modern biotechnology in Cameroon. Several legislative measures contribute to the implementation of the Biological Weapons Convention in Cameroon's criminal legislation. Article 15 of Law No. 2016/015 of 14 December, 2016 on the general regime of arms and ammunition in Cameroon prohibits the development, production, stockpiling, acquisition, transfer and conservation of "(i) microbiological agents or biologicals and toxins, whatever their origin and/or mode of production, type and quantity, which are not intended for prophylactic purposes, protection or for other peaceful purposes; (ii) weapons, equipment or vectors intended for the use of such agents or toxins for malevolent purposes or in armed conflict".

The 2025 Laboratory Guidance Document functions as a key reference for laboratory personnel on the necessary safety measures when handling, transporting, or storing pathogens, toxins, and radioactive materials in Cameroon. It enables both existing laboratories and newly established facilities to comply with physical containment requirements, operational standards, and procedures related to verification and performance assessment. This document was developed through extensive technical, multi-sectoral collaboration among national specialists and development partners, including Metabiota–Johns Hopkins Cameroon, with financial backing from the Global Health Security Agenda (GHSA). It serves as the principal guideline for all biosafety and biosecurity practices within laboratories across Cameroon.

The future of biosafety in Cameroon involves stronger international partnerships, such as with the Global Health Security Agenda and Africa CDC, to improve training, sustainable capacity building, and the implementation of cohesive national, comprehensive, and synchronized frameworks across various sectors, addressing challenges like human capacity gaps and

TABLE 16: CAMEROUN BIOSAFETY AND BIOSECURITY CHALLENGES AND RECOMMENDATIONS

Country Challenges	Recommendation
Weak or outdated regulations	Strengthen and clarify regulations; enforce compliance
Low awareness among lab, farm, border & livestock-trade actors	Nationwide awareness campaigns; targeted risk-communication
Limited funding, staff & equipment	Increase funding, recruit personnel, invest in essential equipment
Poor or insufficient training	Regular capacity-building, drills, and certification programs
Old/weak lab & facility infrastructure	Upgrade infrastructure, modernize labs (including BSL), improve border control
Weak surveillance & data systems	Establish integrated data platforms for outbreaks & biosafety incidents
Weak coordination across sectors & borders	Strengthen One Health collaboration; improve inter-agency and regional
Population movement & porous borders enabling misuse/illegal	Enhance border biosafety controls, livestock movement tracking & enforcement

7.3 Democratic Republic of Congo (DRC) Biosafety and Biosecurity Overview

The DRC biosafety and biosecurity measures for the control of activities that may involve biological agents and toxins are incorporated in Law No. 11/009 of 9 July, 2011, which outlines fundamental principles relating to environmental protection; Law No. 18/035 of 13 December, 2018, which establishes the primary principles relating to the organization of public health and Law No. 14/003 of 11 February, 2014 on nature conservation. The Democratic Republic of the Congo has a specific legal framework governing the registration of facilities whose operation may present a danger to health, security, and environment, through Article 38 of Law No. 11/009 providing fundamental principles relating to environmental protection. Articles 40, 58, and 59 of the same law include specific measures for the safety of these facilities. In addition, the National Institute for Biomedical Research (INRD) and the Mérieux Foundation have organized training sessions related to biosecurity and biosafety, including instruction on sampling techniques, storage, and transportation of respiratory samples, as well as training for laboratory personnel in biosafety and biosecurity protocols.

TABLE 17: DRC BIOSAFETY AND BIOSECURITY CHALLENGES AND RECOMMENDATIONS

Main Gaps / Challenges	Current Strength	Recommendations
Governance & Legal Framework: Fragmented authority; weak enforcement; poor dissemination of rules	National Public Health Laboratory (INRB) plays a central role	Align national laws with Africa CDC model, clarify mandates, strengthen enforcement
Surveillance & Workforce: Weak, untimely surveillance; shortage of trained staff; limited biosafety training	Existing surveillance structure with outbreak history experience	Expand workforce training, improve digital surveillance, incentivize retention
Infrastructure & Logistics: Insufficient lab equipment, BSL capacity, waste management; overreliance on Kinshasa; risky sample transport	INRB has established diagnostic capacity	Decentralize labs, deploy mobile labs, strengthen sample transport and cold-chain
Funding & Sustainability: Chronic underfunding; donor dependence; limited operational budgets	Strong international partnerships	Increase domestic health security funding, integrate into national budget planning
Awareness, Borders & Population Movement: Low community awareness; porous borders; livestock/wildlife trade; informal	Existing cross-border health collaborations (EAC/ECOWAS intersections)	Improve border screening, joint surveillance with neighbors, community sensitization
Health & Security Risks (LAIs): High risk of LAIs due to weak biosafety; recent Ebola infections among health workers	Established outbreak response teams	Strengthen biosafety training, PPE access, and monitoring of Laboratory-Acquired Infections incidents

7.4 JEE of IHR Core Capacities Scores for Central African Countries

The JEE results for Central African countries show consistently weak biosafety and biosecurity capacity across the region. Most countries scored 1 out of 5 in both governance systems and training indicators, reflecting no functional capacity. Only Cameroon showed slightly better performance with a limited-capacity score of 2 for whole-of-government systems, while Congo and the Central African Republic scored 2 for training and practices, but these improvements remain minimal overall (Table 18).
Overall, the region's average scores 1.1 for biosafety and biosecurity systems and 1.3 for training indicate a substantial gap in meeting International Health Regulations requirements. This points to fragile and underdeveloped national structures, with limited coordination across human, animal, and agricultural sectors. The weak training environment further undermines laboratory safety, pathogen handling, and routine biosafety practices.

Taken together, the results highlight that Central Africa remains highly vulnerable to biological threats, laboratory accidents, and zoonotic spillovers due to inadequate systems, poor workforce capacity, and insufficient investment. Strengthening governance frameworks, expanding training programs, and building cross-sectoral capacity remain urgent priorities to improve preparedness and resilience against future epidemics.

TABLE 18: BIOSAFETY AND BIOSECURITY COUNTRY JEES SCORES FOR CENTRAL AFRICAN COUNTRIES

Country	Indicator 1 (Whole-of-government biosafety and biosecurity system in place for human, animal, and agriculture facilities)	Indicator 2 (Biosafety and biosecurity training and practices)	Average score
Gabon	1	1	1
Cameroun	2	1	1.5
DRC	1	1	1
São Tomé and Príncipe	1	1	1
Chad	1	1	1
Congo	1	2	1.5
Central African Republic.	1	2	1.5
Region Average	1.1	1.3	1.2

(WHO). (JEE) Mission Reports for Central African countries, 2017–2023
Scores: 1 = No Capacity; 2= Limited capacity; 3= Develop capacity; 4 = Demonstrated Capacity; 5= Sustainable Capacity

7.5 GHS Index Biosecurity and Biosafety scores for Central African countries

According to the 2021 Global Health Security Index (GHSI), the performance of Central African countries in terms of biosafety and biosecurity remained generally low, with notable variations among individual states.
In terms of biosafety capacity, Gabon and São Tomé and Príncipe ranked highest in the region, each attaining a score of 50%, while the Republic of Congo and the Democratic Republic of Congo (DRC) followed with scores of 23% and 20%, respectively. In contrast, Cameroon and Chad registered the lowest performance with scores of 0%, indicating the absence of meaningful or yet measurable biosafety capacity (Table 19).

For biosecurity capacity, the Republic of Congo recorded the highest score in the region at 15%, followed by the DRC with 13% (Table 19). Cameroon and the Central African Republic (CAR) demonstrated marginal progress, each scoring 4%, whereas Gabon, São Tomé and Príncipe, and Chad all scored 0%, reflecting no observable biosecurity capacity.
At the regional level, the average biosafety score for Central Africa was 20.4%, while the average biosecurity score was 5.1%. These findings underscore the considerable gaps in both biosafety and biosecurity infrastructure and governance across the region, and they highlight the urgent need for coordinated investments, policy reforms, and capacity-building interventions to strengthen compliance with International Health Regulations (IHR) and enhance preparedness for emerging health threats.

TABLE 19: 2021 GHS INDEX BIOSECURITY AND BIOSAFETY SCORES FOR CENTRAL AFRICAN COUNTRIES (HIGHER IS BETTER)

Country	Biosafety Score	Biosecurity Score	Biosafety law	National BSBS Authority	BSL-3 Laboratory
Gabon	50%	0%	Yes	Partial / Mixed	Partial /
Cameroun	0%	4%	Yes	Yes	Mixed
DRC	20%	13%	Partial / Mixed	Partial / Mixed	Yes
São Tomé and Príncipe	50%	0%	No	No	Yes
Chad	0%	0%	No	No	No
Congo	23%	15%	Partial / Mixed	Partial	No
Central African Republic	0%	4%	Mixed / Limited		Yes
Average	20.4%	5.1%			Yes

(Source: GHS Index 2021 data)

CHAPTER 8: REGULATORY AND INFRASTRUCTURAL LANDSCAPES IN SOUTHERN AFRICA

8.0 Current Biosafety and Biosecurity Status in Southern Africa

The southern Africa region is the southernmost part of Africa. The Southern African countries include Angola, Botswana, Eswatini (Swaziland), Lesotho, Malawi, Mozambique, Namibia, South Africa, Zambia, and Zimbabwe.

According to a recent report from the African Society for Laboratory Medicine (ASLM), most countries in the Southern Africa region have biosecurity and biosafety regulations and legislations in place. South Africa has relevant biosecurity and biosafety legislation and has a highly experienced National Institute for Communicable Diseases (NICD) under the Africa CDC's certification framework. Eswatini is currently working on developing a comprehensive framework through a legal mapping and domestication process.

The major regional body involved in biosafety and biosecurity campaigns in the Southern African region is the Africa CDC, which has launched a significant initiative to strengthen Member States' biosafety and biosecurity systems across the continent, including Southern Africa. This work involves creating a regional legal framework, a strategic plan, and training programs for professionals, all designed to meet national, regional, and global standards while promoting a unified approach to biosafety and biosecurity.

Five countries consisting of Botswana, Zambia, Lesotho, Eswatini, and South Africa, were selected from the Southern African bloc because they have more accessible biosafety and biosecurity data, are actively engaged in Africa CDC and ASLM capacity-strengthening initiatives, and represent a useful range of system maturity from advanced (South Africa) to developing (Lesotho and Eswatini). These countries also demonstrate consistent institutional willingness, ongoing legal or laboratory reforms, and alignment with regional assessment priorities, unlike others in the region where data gaps, limited documentation, or inconsistent engagement made inclusion less feasible.

8.1 Botswana Biosafety and Biosecurity Overview

Botswana's biosafety and biosecurity system is still developing, guided by the Biological and Toxin Weapons (Prohibition) Act of 2018. The country is also working on a National Action Plan for Health Security (NAPHS) and a policy on biological resources to close gaps, improve regulations on handling biological agents, ensure lab safety, and prevent misuse. An inter-agency team works under a chemical, biological, radiological, and nuclear (CBRN) Authority to coordinate activities, and Botswana collaborates with the Africa CDC to develop national plans and improve capacity in line with international standards. Botswana collaborates with the Africa CDC in building capacity for handling high-consequence pathogens. Also, there is collaboration with the WHO, which provides tools and support for Joint External Evaluations (JEEs) to assess public health emergency capacities, which have highlighted needs for improved regulatory frameworks in Botswana. Likewise, the country's Action Plan is designed to meet obligations under the UNSCR 1540 UN resolution, which addresses CBRN risks.

TABLE 20: BOTSWANA BIOSAFETY AND BIOSECURITY CHALLENGES AND RECOMMENDATIONS

Gaps / Challenges	Current Strength	Recommendations
Weak governance & no central coordinating authority	Government shows willingness to engage in health security initiatives	Establish a national biosafety & biosecurity coordinating authority, develop national standards, strengthen inter-ministerial consultative mechanisms
Fragmented or outdated legislation; no specific HCAT laws; poor enforcement	Existing biosafety/biosecurity elements within health, agriculture, and environmental agencies	Harmonize frameworks; enact HCAT-specific laws for transfer, storage, certification, disposal; develop a national HCAT list
Underfunded programs; limited domestic financing; dependence on donors	Existing budget lines for health and agriculture that can be expanded	Increase domestic funding allocation, create dedicated biosafety/biosecurity budget lines, mobilize international financing, upgrade labs
Insufficient trained personnel; weak frontline worker training	Botswana has a moderate health workforce foundation and training institutions	Establish national training & certification programs; continuous professional development for lab workers, veterinarians, border officials
Inadequate laboratory infrastructure; lack of advanced containment (e.g., BSL-2/BSL-3 compatible upgrades)	Existing lab networks e.g., public health, veterinary labs	Invest in infrastructure upgrades, equip labs, establish maintenance systems

Gaps / Challenges	Current Strength	Recommendations
Weak multisectoral coordination and siloed approaches	Active sectors in public health, agriculture, environment	Create One Health coordination platforms, routine joint simulation exercises
Limited awareness of biosafety/biosecurity concepts among policymakers and practitioners	Some stakeholders already exposed to basic training	Introduce national biosafety & biosecurity education curriculum; targeted awareness for policymakers, labs, security agencies
Border management challenges: livestock movement, cross-border trade, transboundary diseases,	Functional veterinary & customs services	Strengthen border biosecurity controls; train border officials; improve surveillance for livestock trade and population movement
Risks of misuse of biological materials due to poor controls	Some regulatory processes for diseases of concern	Develop a national biological material control system, improve facility licensing and inspection
Limited data systems & reporting infrastructure	Existing disease surveillance platforms	Enhance digital bio-surveillance systems, integrate human–animal–environment data

8.2 Zambia's Biosafety and Biosecurity Overview

Zambia has a specific legal framework governing the licensing and inspections of research on the contained use of GMOs, outlined in Sections 10, 13, 17, 21, 38, 41, and 45 of the Zambia Biosafety Act, 2007. Zambia also has a specific regulatory framework governing the licensing and inspection of anyone who keeps, transmits, or uses any culture or preparation containing pathogenic microorganisms or other materials capable of causing disease, as outlined in Regulations 53 and 55 of the Public Health (Infectious Diseases) Regulations.
Sections 12, 13, 17, 18, 22-25, 30, 31, 53, 54 and 63 of the Animal Health Act, 2010; Sections 4-7, 9(2), 10, 11 of the Plant Pests and Diseases Act, 1958 (as amended); Regulations 4-14 of the Plant Pests and Diseases (Phytosanitary Certification) (General) Regulations, 2020;
Regulation 9 of the Plant Pests and Diseases (Importation) Regulations 1960 (as amended); Regulations 3-7 of the Plant Pests and Diseases (Pest Control) Regulations, 1958 (as amended); Sections 2-8 of Plant Pests and Diseases (Pests and Alternate Hosts) Order, 1958 (as amended); Part III, IV and V, VI, VII of the Public Health Act, 1930; and Regulations 2-44 and 54 of the Public Health (Infectious Disease)
Zambia's biosafety and biosecurity frameworks are established through the National Biosafety Authority (NBA), which regulates genetically modified organisms (GMOs) under the Biosafety Act, 2007, and through regulations governing public health and animal health. The NBA handles risk assessments, public consultations, and permit processes for GMOs and collaborates with other agencies for inspections.

Other regulatory acts relating to BSBS frameworks in Zambia include:
• The Anti-Terrorism and Non-Proliferation Act 2018: An Act to prevent and forbid activities associated with funding terrorism and the proliferation of weapons or related operations.
• Anti-Terrorism and Non-Proliferation (Amendment) Act, 2022: A legislative instrument enacted to modify the provisions of the Anti-Terrorism and Non-Proliferation Act, 2018.
• Animal Health Act, 2010: An Act established to safeguard animal health by preventing and containing diseases, regulating quarantine measures, and overseeing the trade and movement of animals, their derivatives, and feed materials.
• Plant Pests and Diseases Act, 1958 (as amended): An Act established to ensure the elimination and prevention of the spread of plant pests and diseases within Zambia, to restrict their introduction into the country, and to address related matters.
• Plant Pests and Diseases (Importation) Regulations: Regulating the importation of plant pests and diseases.
• Public Health (Infectious Diseases) Regulations: Regulating the control of infectious diseases.
• National Health Research (Bio Banking) Regulations, 2020: Regulating bio-banking for national health research
• Public Health Act, 1930 (as amended): A law created to prevent and control diseases and to oversee all issues related to public health in Zambia.
• Plant Pests and Diseases (Phytosanitary Certification) (General) Regulations, 2020: Regulates phytosanitary certification for imports.
• Plant Pests and Diseases (Pest Control) Regulations: Regulating the control of pests, including a list of scheduled pests.
• Plant Pests and Diseases (Pests and Alternate Hosts) Order: An order identifying harmful organisms classified as pests for the purpose of their control and the prevention of their dissemination.

TABLE 21: ZAMBIA'S BIOSAFETY AND BIOSECURITY CHALLENGES AND RECOMMENDATIONS

Gaps / Challenges	Strengths / Existing Assets	Recommendations
Fragmented governance; no central authority beyond GMOs	National Biosafety Authority (NBA) exists and provides a starting regulatory framework	• Establish a centralized national biosafety–biosecurity coordinating authority covering human, animal, environmental sectors
Limited multisectoral capacity for risk assessment & HCAT regulation	Technical expertise exists in some labs and universities	• Develop a national HCAT list and registry • Provide specialized training on biosafety/biosecurity risk assessment, regulation, and emergency response
Inadequate laboratory infrastructure (limited BSL-2+, absence of BSL-3) and weak equipment maintenance	Existing lab network for public health and veterinary sectors	• Invest in modern diagnostic labs, maintenance systems • Establish long-term infrastructure funding mechanisms
Funding constraints limiting surveillance, training, infrastructure and regulatory enforcement	Government commitment to health security and donor support	• Develop national sustainable financing strategy for biosafety & biosecurity • Integrate biosafety needs into national budgets & donor
Weak border bio surveillance & informal livestock trade increasing transboundary risks	Zambia participates in regional One Health and SADC surveillance initiatives	• Strengthen border control systems, including screening, bio surveillance, and livestock movement tracking • Train customs, immigration, and port health officers
Limited awareness & compliance among frontline workers (farmers, traders, transporters, laboratory staff)	NGO and government health education platforms exist	• Implement public awareness and sector-specific biosafety training • Develop simplified guidelines for farms, markets, and transport sectors

Gaps / Challenges	Strengths / Existing Assets	Recommendations
Lack of comprehensive national legislation covering all biosecurity domains (beyond GMOs)	NBA Act of 2007 provides regulatory foundation	• Update legal frameworks to cover: dual-use research, lab security, transport of biological materials, pathogen control, and laboratory waste management
Weak inter-agency communication and emergency response coordination	Existing disaster management and public health emergency frameworks	• Create a national biosafety–biosecurity incident reporting system and conduct regular multi-agency simulations
Population movement (refugees, cross-border workers) increasing infectious disease vulnerability	Established community health structures and cross-border health committees	• Expand community-level surveillance, risk communication, and engagement programs
Laboratory waste management gaps and insufficient biosecurity culture	Some facilities follow WHO/CDC guidelines	• Implement national standards for laboratory waste management • Introduce routine inspections and certification systems

8.3 Lesotho Biosafety and Biosecurity Overview

Lesotho has incorporated aspects of biosecurity and biosafety into its criminal legislation, notably the Penal Code Act (2012) and the Prevention and Suppression of Terrorism Act (2018), prohibiting the development, acquisition, and use of biological weapons. Biosafety measures for specific items that may be relevant for BWC implementation are incorporated in the Environment Act (No. 10 of 2008). The Environment Act includes provisions on the licensing (Section 76), registration (Section 80), and inspections (Section 90) of waste management facilities, as well as on the safe storage and management of waste.

Lesotho is actively developing its biosafety and biosecurity (BSBS) framework, focusing on creating national legislation and policies, strengthening laboratory waste management, and improving public health emergency response capacities. While knowledge among laboratory staff exists, there's a need to enhance practices and compliance with regulations to fully improve biosafety and biosecurity.

With support from WHO and the African Society for Laboratory Medicine (ASLM), Lesotho is running programs to develop leadership in implementation research and to improve its public health systems. The country benefits from international initiatives, such as the Africa CDC's Biosafety and Biosecurity Initiative, which provides a framework for strengthening national capacities through coordinated, multi-stakeholder engagement. Lesotho is a party to the Cartagena Protocol on Biosafety and has aligned its legislative framework with regional and global treaties.

TABLE 22: LESOTHO BIOSAFETY AND BIOSECURITY CHALLENGES AND RECOMMENDATIONS

Gaps / Challenges	Strength	Recommendations
Emergency Preparedness: Lack of formalized risk communication strategies, SOPs, and multisectoral coordination for high-consequence events	Engagement in Africa CDC BSBS pilot initiative	Develop and implement standardized SOPs and risk communication plans; enhance multisectoral coordination for emergencies
Human Resource Gaps: Insufficient qualified staff, especially at points of entry; limited awareness among staff	Existing health workforce framework and training platforms	Recruit and train sufficient personnel; implement continuous capacity-building programs focused on border control, livestock trade monitoring, and population movement
Risk Assessment: Weak multisectoral approach, especially for high-risk agents and toxins	Participation in regional risk assessment networks	Strengthen multisectoral risk assessment protocols; adopt a standardized national list of high-consequence agents and toxins
Legislation Gaps: Incomplete laws on lab/facility regulation and pathogen transfer, storage, and disposal	Some existing legal framework for biosafety	Update and enforce comprehensive legislation covering labs, high-risk pathogen management, and biosafety/biosecurity compliance
Resource Constraints: Limited funding and infrastructure hinder BSBS implementation	Support from Africa CDC and regional partners	Secure sustainable financing; invest in infrastructure upgrades (labs, border systems, storage, transport)

Gaps / Challenges	Strength	Recommendations
Lead Entity: No clear authority coordinating BSBS activities across sectors	Pilot country status in Africa CDC initiative	Designate a national BSBS coordinating authority with clear roles and responsibilities
Standards and Training: Lack of detailed national standards and certified training programs	Existing training programs through regional partners	Develop and adopt national standards, certification, and training programs for all BSBS personnel; raise awareness on proper system usage, border controls, and safe livestock

8.4 Eswatini Biosafety and Biosecurity Overview

Eswatini's biosafety and biosecurity framework includes the Biosafety Act 2012, regulating the safe use and transfer of LMOs and/or GMOs, likewise initiating the national implementation of the Cartagena Protocol on Biosafety. Other older laws include the Environmental Management Act 2002, which grants authority to the Minister of Environmental Affairs to regulate hazardous substances, including microorganisms that pose risks to health or the environment. Similarly, the Public Health Act 1969 (as amended) and the Animal Diseases Act 1965 (as amended) provide general or specific controls for biological agents. Efforts are ongoing to strengthen this framework through policy development, professional training, and the creation of national biosafety and biosecurity initiatives, supported by regional efforts and commitments to international conventions like the Cartagena Protocol on Biosafety. The Plant Health Act 2020 is another piece of legislation that provides measures to prevent the spread of plant diseases.

Currently, Eswatini, through its Ministry of Health, in May of 2025, actively engaged in legal mapping and domestication planning process under the Africa CDC-led Biosafety and Biosecurity Initiative (BBI). A policy was developed to establish comprehensive guidelines and legislation for biosafety and biosecurity, according to a report from the African Society for Laboratory Medicine (ASLM). Eswatini joins a growing number of African Union (AU) Member States, including Zimbabwe, Sierra Leone, Burkina Faso, Lesotho, Botswana, and Zambia, that are taking decisive steps to domesticate legal frameworks for biosafety and biosecurity (BSBS) within their national contexts.

TABLE 23: ESWATINI BIOSAFETY AND BIOSECURITY CHALLENGES AND RECOMMENDATIONS

Gaps / Challenges	Strengths	Recommendations
Lack of comprehensive biosafety and biosecurity policies, including oversight for dual-use research of concern (DURC).	Existing legal framework provides a foundation for regulation.	Develop and adopt integrated national biosafety and biosecurity policies with DURC-specific oversight mechanisms.
Limited capacity of trained biosecurity and biosafety professionals.	Some professionals are trained in basic biosafety practices.	Establish nationally recognized training and certification programs for biosafety and biosecurity personnel.
Funding constraints for implementing biosafety and biosecurity measures.	Government and partners show willingness to invest in health security.	Mobilize domestic and international funding to support infrastructure, training, and operationalization of oversight systems.
Inadequate infrastructure and laboratory facilities, including high-containment labs.	Some laboratories meet basic biosafety standards.	Upgrade laboratory infrastructure, including establishing or strengthening BSL-2/3 labs, and ensure proper maintenance and security.
Limited awareness among stakeholders on biosecurity risks related to borders, livestock trade, and population movement.	Awareness campaigns exist at a small scale.	Implement targeted awareness programs for border officials, veterinary services, and communities, focusing on biosecurity and disease prevention.
Weak monitoring and control systems for cross-border livestock trade and high-risk pathogens.	Some monitoring frameworks are partially in place.	Strengthen monitoring systems, including border inspections, reporting mechanisms, and early warning systems for emerging pathogens.

8.5 South Africa Biosafety and Biosecurity Overview

South Africa has a comprehensive biosafety and biosecurity legal framework to manage biological risks. This framework includes various statutes, regulations, and guidelines that cover the safe handling of biological agents, prevention of unintentional release, protection against intentional misuse, and responsible management of genetically modified organisms (GMOs). Annexes A and B of Notice No. R. 4978 of 2024, adopted under section 13(1) of the Non-Proliferation Weapons of Mass Destruction Act, provides a list of microbial and other biological agents, toxins, as well as associated equipment and technologies that could potentially be utilized in the production of biological or toxin weapons, and are therefore classified as controlled items. In accordance with Section 13(3) of the same Act, any individual or entity engaged in activities involving such controlled items, or having them in their possession, custody, or under their authority, is required to register with the South African Council for the Non-Proliferation of Weapons of Mass Destruction.

South Africa has other biosecurity and biosafety-related laws, regulations, and institutions, which include the GMO Act, National Environmental Management: Biodiversity Act (NEMBA), Africa CDC initiatives for regional consistency, and institutions like the National Institute for Communicable Diseases (NICD) and the Academy of Science of South Africa (ASSAf) that provide expertise and guidance. The GMO Act 15 of 1997 regulates the research, development, and release of GMOs into the environment. National Environmental Management: Biodiversity Act (NEMBA) mandates the monitoring of GMO impacts on biodiversity and indigenous species. The African CDC provides training and certification programs to strengthen national capacities, thereby promoting regional biosafety and biosecurity strategies. ASSAf conducts studies and provides guidance on biosafety and biosecurity.

TABLE 24:SOUTH AFRICA BIOSAFETY AND BIOSECURITY CHALLENGES AND RECOMMENDATIONS

Gaps / Challenges	Strengths	Recommendations
Limited high-containment facilities: Only NICD is certified for high-risk pathogens in Southern Africa.	NICD exists as a regional reference lab with high-level biosafety expertise.	Upgrade and expand laboratory infrastructure to handle high-risk pathogens; establish additional BSL-3/4 labs in strategic locations.
Training gaps: Limited specialized biosafety and biosecurity training for frontline lab and farm workers.	Existing training programs at NICD and universities can be leveraged.	Strengthen capacity-building through specialized training programs; implement continuous professional development, including farm-level biosecurity awareness.
Lagging biosecurity policy: Broader biosecurity framework underdeveloped; limited coordination and political prioritization.	Strong GMO biosafety framework provides a policy foundation.	Enhance legislative frameworks by drafting comprehensive national biosecurity laws; integrate agricultural, human, and environmental health under a unified policy.
Funding challenges: Reliance on external funding limits sustainability.	Some international and regional funding streams exist for capacity building.	Develop sustainable national funding streams for biosecurity and biosafety; increase allocations in national budgets and explore public-private partnerships.
Infrastructural & awareness limitations: Weak border control, livestock trade management, and population movement oversight can spread pathogens.	Regional frameworks (e.g., SADC) exist for cooperation on cross-border health issues.	Adopt a “One Health” approach; improve surveillance and monitoring of cross-border movement of people, animals, and biological materials; increase public awareness campaigns on biosecurity risks.
Coordination gaps: Limited integration between human, animal, and environmental health sectors.	Some regional collaboration initiatives through SADC.	Promote inter-sectoral collaboration via One Health platforms; establish Biosecurity Hubs for knowledge sharing and joint response initiatives.

8.6 JEE of IHR Core Capacities scores for Southern African Countries

The JEE table indicates that most Southern African countries have limited or no capacity in implementing a whole-of-government biosafety and biosecurity system for human, animal, and agricultural facilities, with the majority scoring 1 or 2.
Biosafety and biosecurity training and practices are similarly low across the region, although a few countries like South Africa and Zambia show some developed capacity, reflecting regional disparities (Table 25).
Overall, the regional average scores suggest that Southern Africa generally has limited capacity in biosafety and biosecurity, highlighting the need for targeted strengthening of systems, training, and practices.

TABLE 25: JEE SCORES FOR SOUTHERN AFRICAN COUNTRIES

Country	Indicator 1 (Whole-of-government biosafety and biosecurity system in place for human, animal, and agriculture facilities)	Indicator 2 (Biosafety and biosecurity training and practices)	Average score
Angola	1	1	1
South Africa	3	4	3.5
Botswana	1	2	1.5
Lesotho	2	2	2
Namibia	1	1	1
Eswatini (Swaziland)	1	1	1
Malawi	1	1	1
Madagascar	2	2	2

Country	Indicator 1 (Whole-of-government biosafety and biosecurity system in place for human, animal, and agriculture facilities)	Indicator 2 (Biosafety and biosecurity training and practices)	Average score
Mozambique	2	2	2
Zambia	1	3	2
Zimbabwe	1	1	1
Region Average	1.5	1.7	1.6

Source: (WHO). (JEE) Mission Reports for Southern African countries, 2017–2023
Scores: 1 = No Capacity; 2= Limited capacity; 3= Develop capacity; 4 = Demonstrated Capacity; 5= Sustainable Capacity. Source: WHO, Mission Report

8.7 GHS Index Biosecurity and Biosafety scores for Southern African countries

The 2021 GHSI scores indicate that Southern African countries generally have low biosecurity and biosafety capacity, with average scores of 18.6% and 11%, respectively, highlighting significant gaps in preparedness and risk management across the region.
There is considerable variation between countries, with some like Lesotho showing relatively higher biosafety capacity, while most others score very low, reflecting uneven development and limited investment in biosecurity and laboratory safety infrastructure (Table 26).
Overall, the table underscores the need for regional strengthening of both biosafety and biosecurity measures to improve readiness for

TABLE 26: 2021 GHS INDEX BIOSECURITY AND BIOSAFETY SCORES FOR SOUTHERN AFRICAN COUNTRIES (HIGHER IS BETTER)

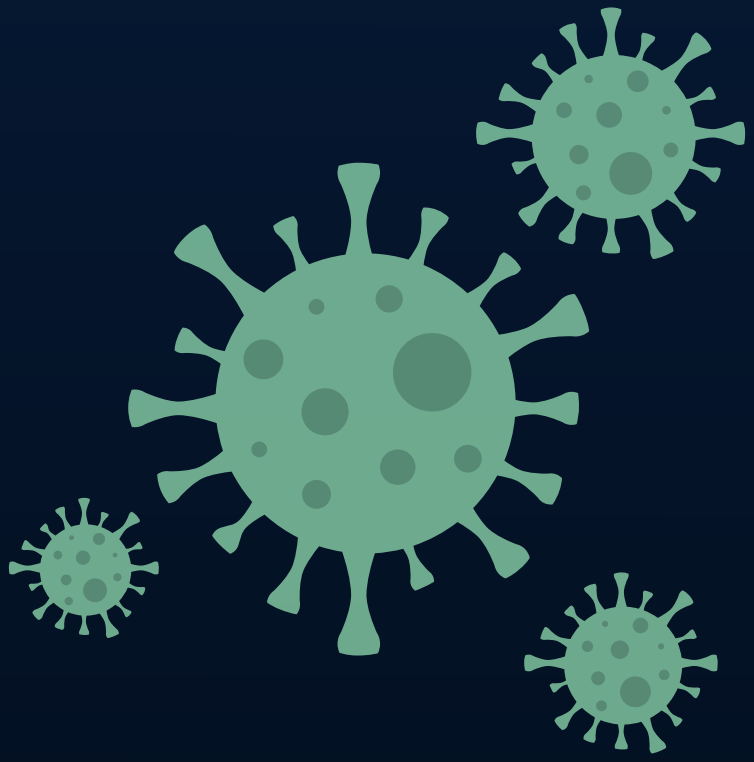
Country	Biosafety Score	Biosecurity Score	Biosafety law	National BSBS Authority	BSL-3 Laboratory
Angola	0%	0%	No	No	No
South-Africa	22%	13%	No	Yes	Yes
Botswana	0%	0%	Limited	No	No
Lesotho	50%	0%	No	No	No
Namibia	23%	15%	Yes	Yes	No
Eswatini (Swaziland)	0%	20%	No	No	No
Malawi	20%	13%	No	Yes	Partial
Madagascar	26%	18%	Partial	Yes	Yes

Country	Biosafety Score	Biosecurity Score	Biosafety law	National BSBS Authority	BSL-3 Laboratory
Mozambique	23%	15%	No	Yes	Yes
Zambia	21%	13%	Yes	Yes	Yes
Zimbabwe	20%	13%	No	No	Partial
Average	18.6%	11%			

(Source: GHS Index 2021 data)

In general, the 2021 GHS Index reveals that countries in sub-Saharan Africa have a low index for both biosafety and biosecurity, indicating limited capacity to tackle biological threats. The results show that biosafety and biosecurity scores are low in all four sub-Saharan regions. Actually, the results were mixed in Central Africa (20.4% biosafety and 5.1% biosecurity), lower in West Africa (16.1% biosafety and 10.3% biosecurity), and roughly similar in East and Southern Africa (18.6% and 11%, respectively).
The average for the entire continent was about 29/100. Every region's score remains below acceptable levels despite modest post-COVID-19 spending, highlighting an urgent need for coordinated investment and policy reforms to bridge these gaps.

CHAPTER 9: SOCIOECONOMIC IMPACTS OF EMERGING INFECTIOUS DISEASES



9.0 Economic Consequences of Emerging Infectious Diseases in Africa

Globally, emerging infectious diseases (EIDs) account for substantial mortality rates. Throughout history, humanity has repeatedly experienced the appearance and re-emergence of various infectious diseases, each leaving behind significant and often devastating consequences. For example, during the 2012–2014 Ebola outbreak in West Africa, the region suffered economic losses exceeding six billion U.S. dollars, while the global economic toll was estimated at around 15 billion dollars (Gostin & Friedman, 2015). During global health crises, the severity of an outbreak and the magnitude of its economic impact often depend on a country's level of preparedness and economic resilience. Many low- and middle-income nations experience severe and long-lasting economic disruptions. For instance, during the 2014–2016 West Africa Ebola crisis, an estimated $2.2 billion in GDP was lost in Guinea, Sierra Leone, and Liberia in 2015 as a result of disrupted economic activity, lowered investment, and reduced cross-border trade (Centers for Disease Control and Prevention [CDC], 2016). Similarly, the total financial cost of the Ebola epidemic across these three countries has been estimated at approximately $2.8 billion, with country-specific losses reflecting varying economic vulnerability (World Finance, 2022). The World Bank further projected economic shocks of this scale in its 2014 and 2015 reports, estimating significant macroeconomic contraction and long-term development setbacks (World Bank, 2014, 2015).

Global economic losses from tuberculosis have also been significant, with studies estimating approximately $12 billion in global economic burden when health care costs, productivity loss, and long-term morbidity are considered.
More recently, the COVID-19 pandemic had profound socioeconomic repercussions across sub-Saharan Africa, with regional GDP losses estimated between $37 and $79 billion due to widespread disruptions in trade, production, and services (World Bank, 2020). The pandemic disrupted agricultural production, weakened supply chains, widened trade deficits, and intensified unemployment and job losses, while also contributing to political instability and policy bottlenecks.
In Ghana, COVID-19 had marked social and economic effects on local markets, including rising food prices, financial hardship during lockdowns, and the relocation of traders to enforce social distancing. Moreover, the decline in global oil demand and exports led to significant trade losses in oil-dependent economies such as Angola, Equatorial Guinea, and Nigeria, consistent with global analyses of pandemic-induced commodity shocks (Africa CDC. (2022).

In the tourism sector, losses amounted to approximately $5 billion (around 2% of 2018 GDP), particularly affecting hospitality and aviation industries in countries like Ethiopia and Kenya, where tourism is a major economic contributor (Africa CDC. (2022). Overall, sub-Saharan Africa lost an estimated $200 billion due to the COVID-19 crisis, accompanied by widespread unemployment, which in turn contributed to heightened social instability, including increases in terrorism, human trafficking, and other societal challenges (World Bank, 2020).
These trends demonstrate that the economic repercussions of global health emergencies are far-reaching, profoundly affecting both developed and developing economies. In Africa, such crises often result in inflation, trade disruptions, withdrawal of foreign investors, and the reallocation of national budgets from developmental programs toward the health sector, thereby slowing progress in other key areas of growth.

CHAPTER 10: FUTURE CHALLENGES: CLIMATE CHANGE, STATE FRAGILITY, AND EVOLVING THREATS

10.0 Emerging Biosecurity Threats in Africa

Africa, in recent years, has faced emerging biosecurity threats that have had a severe impact on health, livelihood, economy, and political stability of the continent. Emerging issues such as climate change, desertification, and terrorism are seriously affecting already fragile states, and there is an urgent need for a comprehensive transdisciplinary approach to address these emerging challenges.

10.1 Climate change and its effects in Africa

Agricultural systems across most African nations are dominated by rain-fed subsistence farming, pastoralism, and fishing, making them highly vulnerable to drought and erratic rainfall that undermine food security and rural livelihoods (Alliance Sahel, 2024). Persistent climate-related shocks have intensified land degradation, reduced water availability, and deepened competition between farmers and pastoralists as agricultural expansion pushes into traditional grazing lands (Econolicy Africa, 2025). These pressures have contributed to livelihood instability and rising insecurity in countries such as Nigeria, Mali, Niger, Somalia, and Burkina Faso, where climate change acts as a threat multiplier for existing socio-political tensions (International Crisis Group, 2025).

In northern Nigeria's Sahelian and Sudano-Sahelian belts, declining rainfall, advancing desertification, rapid population growth, and urban expansion have disrupted migratory corridors between grazing areas, limiting pastoral mobility and heightening farmer–herder conflict (Nomadic Cattle Herders Conflicts in Nigeria, 2020). This situation is especially pronounced around ecologically stressed areas such as the Lake Chad Basin and the Hadejia-Nguru Wetlands. Lake Chad, which has lost nearly 90% of its original size since the 1960s due to climatic shifts and unsustainable water use, has seen a collapse in fishing, farming, and livestock activities that once supported more than 20 million people across Nigeria, Niger, Chad, and Cameroon (UN Institute for Water, Environment and Health, 2023). The lake's depletion has triggered intense competition over shrinking water and pasture resources and increased migration within the basin, escalating inter-community tensions and cross-border pressures (UN Institute for Water, Environment and Health, 2023).

These dynamics have been compounded by the southward movement of pastoral groups from Niger and Chad and the rising presence of Udawa nomadic cattle herders, who have reportedly been armed since the 1990s and often use violence to secure grazing territories (Ahmadu, 2018). Such armed mobility has contributed significantly to farmer–herder clashes and growing insecurity in central and northern Nigeria, where violent incidents attributed to itinerant herders have resulted in numerous civilian casualties and displacement (Reuters, 2025). The Guardian, 2025). Collectively, climate-driven resource scarcity, environmental degradation, and population pressure have created conditions that facilitate the activities of non-state armed groups, including Boko Haram, in the broader Lake Chad region (World Economic Forum, 2019)

10.1.1 Climate change and increasing infectious diseases

Most infectious diseases consist of three fundamental components: a pathogen (the causative agent), a host or carrier (often a vector), and an environment that enables transmission. Certain pathogens depend on vectors or require intermediate hosts to complete their life cycles. Suitable climatic and weather conditions are essential for the survival, reproduction, distribution, and transmission of disease-causing organisms, their vectors, and hosts. Consequently, variations in climate or weather patterns can influence infectious diseases by altering the dynamics of pathogens, vectors, hosts, and their habitats. Studies indicate that prolonged climate warming frequently facilitates the expansion of many infectious diseases, such as malaria, dengue, and other vector-borne infections, into previously unaffected regions. Rising temperatures and altered precipitation patterns increase the climatic suitability for disease vectors like Anopheles and Aedes mosquitoes, extending their geographic range and lengthening transmission seasons in regions that were once too cool for sustained transmission (Thomson et al., 2022. Additionally, extreme weather events (e.g., heavy rainfall, floods, and heatwaves) associated with climate change can create favorable breeding conditions for vectors, disrupt health infrastructure, and trigger large-scale outbreaks in atypical locations and seasons (Klepac et al., 2024; World Health Organization, 2024).
Overall, climate factors regulate the geographical and seasonal ranges of infectious diseases, whereas short-term weather patterns influence the timing and magnitude of disease outbreaks. An increasingly warmer and more unstable climate is significantly contributing to the global emergence, resurgence, and redistribution of infectious diseases (IPCC, 2022). Many widespread infectious diseases, particularly those transmitted by insect vectors, are highly responsive to climatic fluctuations such as temperature, precipitation, and humidity (Altizer et al., 2013).

Re-emerging and newly arising vector-borne diseases, including dengue fever, malaria, hantavirus infection, and cholera, are becoming more prevalent globally as climate change expands vector habitats and prolongs transmission seasons (WHO, 2023). In addition, enteric and water-borne infections such as salmonellosis, cholera, and giardiasis are projected to increase in frequency due to frequently increasing temperatures, flooding, and disruptions to water and sanitation systems (IPCC, 2022; WHO, 2014). Climate change will continue to reshape infectious disease risk patterns reducing transmission in some regions while creating favorable ecological conditions for disease emergence in others thereby necessitating comprehensive, interdisciplinary adaptation and surveillance strategies (Altizer et al., 2013).

Across Africa, infectious disease incidence is increasing due to rapid population growth, environmental degradation, urbanization, changes in land use, and shifting socio-economic conditions, all of which are further exacerbated by climate change (IPCC, 2022). Climate-sensitive diseases such as malaria, dengue fever, and cholera are expected to intensify as global temperatures rise and extreme weather events become more frequent (WHO, 2023). Approximately 75% of emerging and re-emerging infectious diseases affecting humans are zoonotic in origin, arising from increased contact between humans, wildlife, and livestock driven by deforestation, urban expansion, and climate-related ecosystem disruption (Jones et al., 2008; Carlson et al., 2022). Consequently, diseases such as Lassa fever, Ebola virus disease, and monkeypox have shown increasing frequency and geographic spread in recent decades, particularly in parts of Africa experiencing rapid environmental and climatic change (Jones et al., 2008; IPCC, 2022).

10.2 2025 Global Peace Index (GPI)

The Global Peace Index (GPI) encompasses 99.7% of the global population and utilizes 23 qualitative and quantitative indicators sourced from reputable institutions. It assesses the level of peace across three major thematic dimensions: Societal Safety and Security, Ongoing Domestic and International Conflicts, and Militarization. According to the most recent Global Peace Index published on June 18, 2025, by the Institute for Economics and Peace (IEP) an Australian-based research organization Mauritius, Botswana, and Namibia are recognized as the most peaceful nations in Africa for 2025. Out of the 50 African countries reviewed in the report, 26 experienced a deterioration in peacefulness compared to 2024, while 22 showed improvements, and two remained unchanged (IE&P, 2025). On average, Sub-Saharan Africa's peace score decreased by 0.17% from the previous year, reaffirming its position as the region with the highest concentration of conflicts 36 out of 44 countries have been involved in some form of conflict over the last five years. This represents a significant increase from only seven nations in conflict in 2008. Mauritius holds the 26th position globally with a score of 1.586, maintaining its status as Africa's most peaceful country for the 18th consecutive year. Botswana ranks 43rd worldwide, placing second in Africa, while Namibia occupies 50th place globally, making it third on the continent (IE&P, 2025). Other African nations ranking among the top 10 most peaceful include The Gambia (55th), Sierra Leone (57th), Madagascar (59th), Ghana (61st), Zambia (64th), Senegal (69th), and Liberia (70th).

10.2.1 Fragile State Index (FSI)

A fragile state is one that struggles to perform basic duties like reducing poverty, supporting development, protecting security, and ensuring human rights. It also lacks either the ability or the political will to build strong, cooperative relationships with its society (OECD/DAC, 2010).

Most countries in sub-Saharan Africa are classified as very fragile, with most of them having high fragile state index scores. Africa has the most fragile countries, with over 19 African countries having a 90-index score. The countries with the highest index scores are Somalia, Sudan, DR Congo, CAR, Chad, Ethiopia, Mali, Nigeria, Libya, Guinea, Zimbabwe, Niger, Cameroon, Burkina-Faso, Burundi, Mozambique, Eritrea, and Uganda. These countries are very fragile and are on alert.

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Conclusion

A variety of legislative tools and policy initiatives have been implemented across African nations to tackle biosafety and biosecurity challenges. The development of several new frameworks, laws, and institutions has largely been influenced by multiple international agreements, conventions, and health security protocols to which African states are signatories. However, the effective enforcement of these laws and policies remains challenging due to the shortage of qualified personnel and inadequate institutional capacity to ensure proper implementation. Significant gaps continue to exist in biosafety and biosecurity infrastructure throughout the continent, as most countries in the region have limited capacity in these areas. There is an urgent necessity to strengthen biosecurity and biosafety systems within Africa. The growing frequency of emerging infectious diseases combined with environmental degradation, population growth, weak governance structures, and the rising influence of non-state actors has amplified biosecurity risks across the region. Future biosecurity threats could arise from the mishandling or deliberate misuse of high-risk pathogens and toxins, non-compliance with government regulations on sensitive life sciences research, insider or external breaches at laboratories handling biological materials, and inadequate safety measures or traceability during storage, transfer, and transportation. Enhancing the capacity of the Africa Centres for Disease Control and Prevention (Africa CDC) and National Public Health Institutes (NPHIs) is vital to enable a coordinated, multisectoral response to these challenges. To strengthen preparedness, Africa must invest heavily in developing its public health workforce and substantially increase regional production capacity for vaccines, diagnostics, and therapeutics. Currently, the continent manufactures only about 1% of its vaccines, making large-scale local production a strategic priority. Achieving this will require innovative and sustained investments in process optimization, manufacturing infrastructure, product development, and life cycle management. Building human and institutional capacity remains a cornerstone for addressing emerging biosecurity threats in Africa. Establishing a comprehensive biosafety and biosecurity training curriculum that promotes responsible research practices and encourages a culture of safety and security in science is essential. Moreover, the continent needs a well-defined and harmonized framework to oversee laboratory operations and biobanking activities, ensuring both safety and accountability.

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APPENDIX 1
EMERGING INFECTIOUS DISEASES IN AFRICA

Disease Type	Origin	Causative Agents /Host	Countries Affected	Transmission	Prevention	Symptoms	Diagnosis and treatment
Parasitic							
Malaria[b]	ND	Plasmodium parasites /Mosquitoes	All countries, according to the WHO World Malaria Report 2020. Africa accounts for 93% of the global burden	Female Anopheles mosquito bite, mother to child, blood transfusion	Vector control, vaccination	Range from mild, absent, severe, including: fever, chills, headaches,	Microscopy or rapid diagnostic test; antimalarial drugs
Dracunculiasis (Guinea-worm)	ND	Parasite Dracunculus medinensis/copepod	2020 (Ethiopia), 2019 (Angola, Chad, South Sudan, Cameroon), 2017 (Ethiopia)	Drinking water containing copepods	Guinea worm eradication programs	Asymptomatic for about 1 year, symptoms include slight fever, itchy rash, nausea, vomiting, diarrhoea, and dizziness	Physical diagnosis: worm removal, topical antibiotic treatment of the wound, and pain relievers to reduce pain and inflammation

Disease Type	Origin	Causative Agents /Host	Countries Affected	Transmission	Prevention	Symptoms	Diagnosis and treatment
Bacterial							
Meningococcal	ND	Bacterium Neisseria meningitidis/Humans	2017 (Nigeria, Togo), 2015 (Niger), 2013 (South Sudan), 2012 (Chad), 2011 (Chad)	Person-to-person through droplets	Vaccination, chemoprophylaxis	Common (fever, headache, stiff neck), septicaemia	Clinical examination, culture, agglutination test, PCR; Antibiotic treatment
Cholera	India (19th Century)	Bacteria Vibrio cholerae/Unknown natural host	2021 (Togo), 2018 (Zimbabwe, Niger, Algeria, Cameroon, DRC, Mozambique, Tanzania), 2017 (Zambia, Kenya, Nigeria), 2015 (DRC, Tanzania), 2012 (Sierra Leone, DRC), 2011	Ingestion of food or water contaminated with V. cholerae	Vaccination, safe water, and sanitation	Mostly mild or moderate with minor acute watery diarrhoea	Clinical symptoms, rapid diagnostic tests, culture, PCR; timely administration of oral rehydration solution, antibiotics, and intravenous fluids for severe cases
Tuberculosis	ND	Bacterium Mycobacterium tuberculosis/Humans and animals	According to the WHO global tuberculosis reports (2011–2020), all countries reported cases. High burden countries (South Africa, Kenya, Mozambique, Namibia, Sierra Leone, Tanzania,	Aerosol transmission	Vaccination, safe respiratory habits	Generally, include weakness, weight loss, fever, and night sweats	Culture, skin and blood tests, NAATs, drug susceptibility tests; and Antibiotic therapy

Disease Type	Origin	Causative Agents /Host	Countries Affected	Transmission	Prevention	Symptoms	Diagnosis and treatment
Typhoid fever	ND	Bacterium Salmonella Typhi/Humans	2015 (Uganda)	Consuming contaminated food or drinks	Vaccination, proper hygiene, and access to clean water	High fever, headache, fatigue, nausea, abdominal pain, and constipation or diarrhoea	Culture, antibody tests, and Antibiotic treatment
Plague	ND	Bacteria, Yersinia pestis/Rodents and their fleas	2017, 2015 (Madagascar)	Flea bite, contaminates tissues/fluids, infectious droplets	Sensitization and avoiding carcasses	Symptoms depend on plague type, i.e., bubonic/pneumonic/septicemic The difference between pregnant and non-pregnant women. For non-pregnant headache, confusion, stiff neck, loss of balance, and convulsions	Bacterial culture and antibiotic treatment

Disease Type	Origin	Causative Agents /Host	Countries Affected	Transmission	Prevention	Symptoms	Diagnosis and treatment
Viral							
Monkeypox	DRC (1970)	Monkeypox virus/Unknown natural host	2020 (DRC), 2018 (Nigeria, Cameroon), 2017 (Nigeria), 2016 (CAR)	Human-to-human, wild animals like rodents and primates	Vaccination, risk factor awareness, and education	Fever, rash, and swollen lymph nodes	Clinical symptoms, PCR; No specific treatment
Ebola virus disease (EVD)	DRC (1976)	Ebola virus/Bats or NHP	2021 (Guinea, DRC), 2020 (DRC), 2019 (DRC, Uganda), 2018 (DRC), 2014 (Mali, Liberia, Guinea, Nigeria, Sierra Leone, DRC, Senegal), 2012 (DRC, Uganda), 2011 (Uganda)	Infected animals, person-to-person, semen	Vaccination, avoid contact with infected animals and persons, semen, blood, and body fluids.	Primary symptoms include fever, loss of appetite, sore throat, weakness and fatigue, aches and pains, gastrointestinal symptoms, unexplained bleeding, bruising, or hemorrhaging.	Isolation, blood test, PCR, drugs, and supportive care
COVID-19	China (2019)	SARS-CoV-2/ Bats	All (Ongoing)	Respiratory droplets, contaminated surfaces, and hands	Vaccination, wearing of masks, and avoiding crowded locations	Mild to severe, including: cough, fever/chills, shortness of breath, fatigue, muscle/body aches, headache, etc.	Isolation, NAATs, serology; Antiviral drugs and supportive care

Disease Type	Origin	Causative Agents /Host	Countries Affected	Transmission	Prevention	Symptoms	Diagnosis and treatment
Rift Valley fever (RVF)	Kenya (1931)	RVF virus/Several mosquito spp.	2021 (Kenya), 2018 (Gambia, Kenya), 2016 (Angola, Niger, Uganda), 2014 (Senegal)	Blood or organs of infected animals, raw milk, and mosquitoes	Animal vaccination	No to mild symptoms, severe include ocular disease, encephalitis, and haemorrhagic	RT-PCR, serology, cell culture; no specific treatment (often self-limiting), supportive care in severe cases
Lassa Fever	Nigeria (1969)	Lassa virus/ Mastomys rats	2019 (Nigeria), 2018 (Nigeria, Liberia), 2017 (Nigeria, Benin), 2016 (Benin, Nigeria, Liberia, Togo), 2014 (Benin), 2012 (Nigeria), 2011 (Ghana)	Exposure to the urine or faeces of infected Mastomys rats, person-to-perso n	Community engagement and promoting hygienic conditions	Mild and severe, including haemorrhaging, repeated vomiting, respiratory distress, pain, and facial swelling	RT-PCR, serology, cell culture, antiviral drug
Chikungunya fever	Tanzania (1952)	CHIKV/Mosquitoes	2020 (Chad), 2019 (Congo), 2018 (Sudan, Kenya), 2016 (Kenya, Somalia), 2015 (Senegal)	Infected mosquito bite	Vector control	Fever, severe joint pain, muscle pain, joint swelling, headache, nausea, fatigue, and rash	RT-PCR, serology, cell culture; treatment based on relieving symptoms

Disease Type	Origin	Causative Agents /Host	Countries Affected	Transmission	Prevention	Symptoms	Diagnosis and treatment
cVDPV2	ND	Reverted live-attenuated OPV/humans	2020 (Sudan, Somalia), 2019 (Somalia), 2018 (Niger, Nigeria, Somalia), 2017 (DRC)	Person-to-person	Development of a new vaccine type 2 monovalent OPV (mOPV2), vaccination	Paralysis	RT-PCR and sequencing; no specific treatment
Measles	ND	Measles virus/Humans	2020 (Burundi, CAR), 2019 (Tunisia)	An infected person coughing or sneezing	Vaccination	High fever, cough, runny nose, red, watery eyes, Koplik spots, rash	Clinical symptoms, blood and throat swabs, blood tests; no specific

A report of the disease outbreak in the past decade (2011-2021).
Not classified as an outbreak, but it caused many deaths in Africa.
ND: Not determined (unclear); NAATs: nucleic acid amplification tests; cVDPV2: circulating vaccine-derived poliovirus 2; OPV: oral polio vaccine; CAR: Central African Republic; RT-PCR: Reverse transcription polymerase chain reaction.

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